

**APPENDIX T.1**  
**Portfolio Class Profile Form**

SC4075

Portfolio Sequence Number

**DIRECTIONS:** Photocopy or download this form (<http://www.ctbest.org>, click on "Portfolio Resource Documents") and fill it out completely. Include it as the **COVER PAGE (first page)** of your portfolio.

1. Grade level(s) in your portfolio class: pre-k k 1 2 3 4 5 6 7 8 9 10 11 12  
(Circle all that apply)

Portfolio school configuration : ☐ ELEMENTARY ☐ MIDDLE SCHOOL  
☒ HIGH SCHOOL ☐ SPECIAL EDUCATION FACILITY

2. Portfolio content area (check appropriate box and blank):

☐ ELEMENTARY

☐ ENGLISH LANGUAGE ARTS

☐ MATHEMATICS: Course name: \_\_\_\_\_

☐ MUSIC \_\_\_ Choral \_\_\_ Instrumental

☐ PHYSICAL EDUCATION

☒ SCIENCE \_\_\_ General ☒ Biology \_\_\_ Chemistry \_\_\_ Physics \_\_\_ Earth

☐ SOCIAL STUDIES \_\_\_ World History \_\_\_ U.S. History \_\_\_ Geography  
\_\_\_ Ancient Civilizations Civics/Government \_\_\_ Other

☐ SPECIAL EDUCATION \_\_\_ Language Arts \_\_\_ Mathematics

☐ VISUAL ARTS \_\_\_ Drawing/Painting \_\_\_ Ceramics \_\_\_ Photography  
\_\_\_ Printmaking \_\_\_ Sculpture \_\_\_ Crafts Other: \_\_\_\_\_

☐ WORLD LANGUAGES \_\_\_ French \_\_\_ Spanish \_\_\_ Italian \_\_\_ Other (please specify)

3. Portfolio Teaching Topic/Unit Title: NERVOUS SYSTEM

4. Number of minutes per class: 4/5 - 83 min

5. Total number of students in class: 17  
# of boys 3 # of girls 14 # of LEP students 0 # of special education students 0

6. Primary texts or electronic resources used in portfolio unit, if applicable. (Please provide title, author/publisher, and date of publication of all textbooks; website addresses from which unit content or materials were used.)

MODERN BIOLOGY - Holt Rinehart + Winston 2002  
Biology by Miller A-D Levine 2004 Prentice Hall and Lab Manual "A" same text  
<http://faculty.washington.edu/chadler/5sec.html> <Neuroscience for Kids>  
<http://www.exploratorium.edu/ti/home-body/visual-effect.html>

(Note: Elementary education teachers should provide this information for both literacy and numeracy instruction)

7. Number of other adults in the room during portfolio instruction: 0

Indicate all that apply \_\_\_ paraprofessional \_\_\_ co-teacher \_\_\_ parent volunteer \_\_\_ other

## APPENDIX T.2

### Science Portfolio Unit Overview

Course Biology Grade level 9<sup>th</sup>

Unit's Essential Question:

WHAT ROLE DOES THE SPINAL CORD  
AND PERIPHERAL N.S. PLAY IN THE HUMAN BODY?

Lesson Date	Lesson's Main Concept	Students' Main Learning Activity
3/5/04	STS INTRODUCTION STRUCTURE OF SPINAL CORD, COLUMN, MICROSTRUCTURE	INDIVIDUAL GROUP WORK ON WWW
3/8/04	REFLEX ARCS; AXON TRANSMISSION	NOTE TAKING DISCUSSION MODEL BUILDING COOPERATIVE LEARNING LECTURE NOTE TAKING
3/9/04	REFLEXES VS. REACTIONS; PATHWAYS INVOLVED/STRUCTURES	LECTURE NOTE TAKING MODEL BUILDING
3/10/04	RESTING VS. ACTION POTENTIAL; INQUIRY LAB	INQUIRY LAB WORKING IN SMALL GROUPS SCIENCE INVESTIGATION NOTE TAKING
3/11/04	REACTION TIME AND AGING; EXPERIMENTAL VARIABLES IN INQUIRY LAB	POST LAB DISCUSSION STUDENTS READING ARTICLE DISCUSSION
3/12/04	STS PRESENTATIONS DEBATE ON BIOTECHNICAL PROBLEMS WITH TREATMENT	STS PRESENTATIONS AND DEBATE DISCUSSION
3/15/04	UNIT ASSESSMENT	ASSESSMENT OPEN/CLOSED END QUESTIONS

### **Introduction:**

**What essential question and main concepts will students explore during this unit?** The question students will be exploring during this unit is what roles do the spinal cord and peripheral nerves play in the human body. The position and anatomy of the spinal cord will be introduced. The anatomical structures that allow the spinal cord to serve as part of the central nervous system and allow it to interface with the peripheral nervous system will be examined. Transmission of nerve impulses along axons will be examined also. We will define the role of the peripheral nervous system in maintaining homeostasis. Interruptions and injury to the spinal cord, and their devastating consequences will be used to demonstrate the important role this very delicate structure plays in the human body. Students will investigate treatment of spinal cord injuries and discuss the merits and controversy surrounding the issue of using stem cells. The goal of this unit is to prepare students to examine a societal issue through one aspect of human anatomy and physiology, and better-prepare them to debate, and ultimately, decide the future use of technology in the human arena.

### **How are these concepts connected to student learning before and after this unit?**

Instruction preceding this unit focused on the Central nervous system, specifically the brain. The focus concept was the role of the nervous system in stability and homeostasis of the organism. Structure of a neuron as the basic unit of the nervous system was covered. Comparisons were made across the mammalian spectrum and even primitive life forms with rudimentary nervous systems were introduced to illustrate that without a functioning system that allows the organism to read and respond to the environment, the health of the person is compromised. Homeostasis is a fundamental concept to life and this has been a recurring theme from our first analysis of cells to multi-cellular life -forms. The role that the spinal cord and peripheral nervous system play in homeostasis will build on this. Students were previously introduced to the "Neuroscience for Kids" website. This website will be used often, both in class and by students completing their projects. After this unit the role of sensory systems and homeostasis will be studied.

**What do you know about students' ideas and learning needs relative to the unit's essential question prior to the start of the unit?** My students are happy ninth graders, who like to investigate topics through their own efforts. They need more integration of mathematics as a tool of science. At the beginning of the term my students completed a project where they had to research a career that is based in Biology. A list of over 100 different careers that had biology at their core was provided.

They were allowed to choose the career. This was done to gauge their interests and their overwhelming interest was in the medical arts. I focus on using real world medical examples wherever possible as it plays to their interest. I find that this very social group of students work well together in small groups. The intrapersonal learners will benefit from lab assignments and other activities that allow them to engage each other in the learning process.

My students need to have a variety of instructional strategies to engage their different intelligences. I have ample access to visual technology in the classroom including SmartBoard and multimedia projection. This allows me to engage students who learn visually with projected diagrams, images and PowerPoint style instruction. A couple of students are auditory learners who can take effective notes from what is stated in class. A couple of my students learn in a kinesthetic mode will benefit from taking complex concepts and building simple models to explain them. The student will be allowed to choose the method of displaying the knowledge they acquire in the unit project by different methods that are comfortable to them (e.g., written, graphic, oral presentation).

**How do you plan to apply what you know about your students' ideas and learning needs to make the portfolio interesting and accessible and relevant to your class?** Considering the high level of interest in medical fields by my students, I will require them to explore an STS topic that relates to treatment of spinal cord injuries. Because their intelligences take different forms, a variety of instructional formats will be used including group work. I will arrange computer and website access to allow them to continue to integrate technology into their studies. An inquiry lab will allow them to explore what factors, external and internal, can affect reflexes and reaction time. This unit has an interdisciplinary component to it. My school is organized into clusters. At my request the other teachers for these students, in English, Math and Health will explore integral aspects that enhance the learning needs of these students with respect to the essential question. In Math the students will calculate reaction times from raw data obtained in the inquiry lab. The health teacher and I will work closely, as we have so far during the Human Biology section. The health teacher will explore at-risk behaviors for spinal cord injuries. Our English teacher will fulfill a dual role and assist the students on preparation of their STS projects. He will also use his knowledge as an attorney to explore the legal aspects of those who live with spinal cord injuries and the legalities of current medical research in stem cells to treat these injuries.

**Lesson Log-3/5/04**

**Day #1 Length of Class-83 min**

**What did you expect students to learn during the lesson?** I expected the students to identify what activities could be affected by a damaged spinal cord. I also expected students to investigate the anatomy of the spinal cord and spinal column using the supplied website.

Students were to differentiate between white and grey matter. I expected the students to identify structures of the spinal cord and PNS from cross sectional diagrams. Students were asked to report their findings and hand them in as a "ticket to leave." I also expected students to begin to research their STS project and familiarize themselves with the projects goals and. requirements.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** Students were introduced to the unit concepts and STS project by first viewing the videotape "The Spine-Command Central", a *Science Screen Report* production. Students participated by taking notes. This video looked at the structure of the spinal cord, and how injuries affect movement. Important to the unit objective the video focused on current medical advances in treating spinal cord injuries. This video was twelve minutes long, but has many dramatic images; of persons living with spinal cord injuries (s.c.i) and undergoing physical therapy and using assistive technology. I stopped the tape to highlight both Functional Electrical Stimulation (FES) and the use of stem cell technology.

I asked the students if they knew of a famous person living with an s.c.i. Virtually everyone had some knowledge of what happened to Christopher Reeve. Following the videotape important vocabulary terms were listed on the board. Students copied these into their notebooks and used these to organize their reading for homework tonight. Using a "dry spine" anatomical model I showed the class the relationship between the spinal column and the spinal cord. I then used a PowerPoint type presentation, that included structural diagrams and cross sectional anatomy, to highlight the regions of the spinal cord. The requirements for the STS project "Spinal Cord Injuries and Society" were distributed, including a list of websites for the students to use as starting points for their investigations. We moved to the computer lab and students worked individually using the "Neuroscience for kids" website to review the previously identified vocabulary terms, and spinal cord /column structures.

**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.** One of my students noted how she was shocked at how young the Injured people were that she saw in the videotape. I asked the class if they too were surprised by this and most said they were. This helped reinforce the concept that these injuries are most often seen in younger people who must face a long period of disability

following an injury. When reviewing the fact sheet on spinal cord injuries, students were confused by the medical terminology that organized the facts. After the PowerPoint presentation I brought the diagrams back up and called on students to identify the structures as part of their participation grade. Some students were confused by terms dorsal and ventral, and I clarified this immediately by reminding them of a shark's dorsal fin. Most of the students identified this as a structure on the back of the shark. The dorsal side of the spinal cord was put into context as being the side closest to the back.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.** The need to clarify the medical terminology was important. I used plain language to clarify the confusing terms. For example, 'incidence' was redefined as "How often it happens". Although the anatomical model was life size, I made the students pass it around. Every student was able to touch the model structures while viewing the pictures displayed on the SmartBoard. This helped address the issue that students were mixing terminology of cord and column. I used a wire molding in the computer lab as an example. The wires inside the wire molding were compared to the spinal cord and the hard plastic wire molding was related to the vertebrae and soft tissues of the spine. The diagrams used on the PowerPoint presentation as compared to their textbook and the website all had subtle differences. These differences were confusing to some students. I walked around the lab and made sure students were using the correct pages. During the investigative phase several students were wandering through the website. To make sure they were focusing on the pages I wanted them to view I displayed the appropriate pages through the projector for the whole class to see simultaneously. At this point I wrote several questions on the white board for students to answer using the website. I had originally designed the STS project to be done individually, but several students wanted to work together and asked me if they could. I allowed one group to work together on a poster, but I asked them to expand the poster size to 24x30 to compensate for the additional help they would have to finish the project.

March 5, 2004

31 pair spinal Nerves (PNS)

Spinal cord (CNS)

18" long / width of little finger

Good work  
Today!

Keep this in  
your Notebook

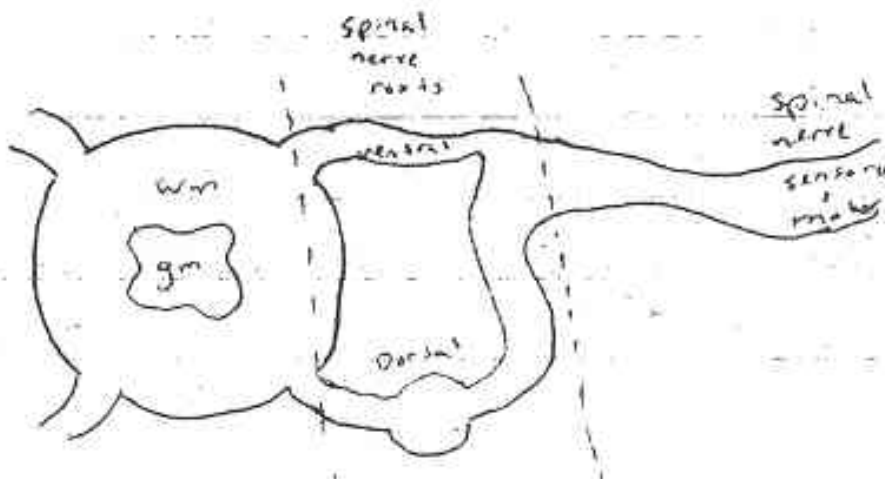


grey matter  
→ cell bodies  
→ dendrites  
→ neuron

white matter  
→ myelinated axons

information that travels from the body to the brain: sensory

information that travels from the brain to the body: motor



brain + spinal cord make up the CNS

spinal cord begins at the end of the brain and ends at the pelvis

There are 24 vertebrae, it protects the spinal cord.

The vertebrae are connected by ligaments.

The disc in our back, absorbs shock, of walking, running, and swimming

The discs in the vertebrae prevent us from getting hurt

The inability to move a body part is called paralysis.  
paralyzed from the waist down is paraplegic.

There is a protein in the body that prevents ~~the~~ nerve cells from growing back



**Lesson Log-3/8/04**

**Day #2 Length of Class-46 min**

**What did you expect students to learn during the lesson?** I expected them to learn about current controversy surrounding stem cell research including viewpoints of advocates for stem cell research. I expected students to be able to name the two divisions of the peripheral nervous system and describe their function. I wanted them to understand the role the sympathetic and parasympathetic nervous systems play in maintaining the human body, and coordinating its responses to the different situations encountered in life. We needed to review the structure of neurons and describe the transmission of impulses along a neuron.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** Due to the shortened period because of an assembly, students were handed an article to read as they entered class. It examined the controversy surrounding stem cell research and its strong advocate Christopher Reeve. I asked the students what their thoughts were on this issue. One student remarked that he was surprised to see that Mr. Reeve and the President were "fighting." I clarified that debate, argument and disagreement among adults while heated should not be confused with fighting. A student offered that she could understand his frustration at being disabled and hoped that research would be able to proceed soon. After this short debate I led the class through a PowerPoint presentation which outlined the organization of the peripheral nervous system. We defined the PNS as including the somatic and autonomic nervous systems. One student asked the question "I thought we only had one nervous system." I explained that is true, but biologists use these terms to identify the functions of different parts of the overall nervous system. We identified two roles of the somatic nervous system including voluntary and involuntary (reflex) movements. I showed the students a reflex hammer and asked them if they had ever seen one before. They all had and several students knew that it was used to test reflexes. I agreed, and then told them that the reflex is a window into how well the involuntary part of the somatic nervous system works. The autonomic nervous system was identified by the functions it coordinates in the human body. The sympathetic nervous system was identified by how it works to prepare the body for defense or to run from trouble. In addition I showed on a diagram where the sympathetic nervous system enters and leaves the spinal cord and how this part of our nervous system could be affected by a spinal cord injury. I asked students to answer questions on an "exit card" to measure their understanding of today's

concepts. I found that even with a motivated group such as this that making the exit card a graded assignment seemed to insure participation. I asked students to assemble an apparatus by hooking a tube to a funnel, and pour a volume of water through it. Two different diameter tubes were supplied to each group. I had the students pour a volume of water into the model. The model included two different diameter tubes to show axons of different diameter. The students timed how long it took for the water to pass through the tubes. I had the students display their data on the board. This was done to reinforce the concept that large diameter axons transmit impulses faster than smaller axons.

**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.** Terminology in this section can be confusing as the terms sympathetic and parasympathetic are close but mean vastly different things. I gave many hypothetical situations to the class including being asked to give a speech in front of the whole school and performing in a school play. Students answered by identifying each situation as being a sympathetic or parasympathetic "event". During the activity I circulated around the room and asked individual students to demonstrate what they observed with the activity. I asked students to compare the model to a neuron and what neuron structure the tube is analogous to. Most students were able to correctly identify the tube as being a model of an axon. Some even offered that the funnel was like the dendrite and cell body of a neuron collecting information and passing it on. After the activity I allowed these students to tell the class their findings and one offered to draw the model on the board. I challenged him to identify the different parts of the model with the names of neuron structures based on their function. I had the students copy this into their notes. The activity groups displayed their time data on the board, and we came to the conclusion that larger axons probably conduct impulses faster because of less resistance.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.** The article that the students read did not include the viewpoints of those opposed to embryonic stem cell research. I supplied this information to the students, by displaying an image on the SmartBoard of a news article which outlined President Bush's objections to stem cell research. During the activity some students got conflicting data based on how fast they poured the water into the funnel. I had to remind the class that the entire volume of water must be dumped into the funnel as quickly as possible to limit experimental error.

9/10 GOOD JOB TODAY!

Suppose you find yourself hiking Mt. Adams in New Hampshire and you come around a corner and find yourself face to face with a huge Black Bear! What part of your PNS will allow your body to react to and prepare to deal with this potential threat? How does this division of the PNS assist us in these types of situations?

(3 points) The ~~para~~ sympathetic system because when you feel a threat of physical attack, this system will redirect the blood flow to your heart and skeletal muscles.

Why is it important to have your skeletal muscles because you have to be ready? Always or fight!

Considering the situation in question 1, in what region of the spinal cord would you be able to measure increased neuron activity? Why? How could a spinal lesion at the level of T5 or above affect the Sympathetic branch of the Nervous System (3 Points)

T1 - L2. The neurons would have to work harder because ~~they~~ they send and transmit impulses to and from the brain.

The neurons of the Sympathetic N.S. would not be able to communicate with the brain!

Sketch a diagram of the apparatus used in class to demonstrate speed of conduction in an axon, and explain its significance? (2 points)



It shows us how fast smaller and larger axons conduct impulses.

GOOD!

What type of an axon conducts an impulse the fastest? How fast is the fastest conduction in an axon? What substance speeds up conduction through an axon?

(2 points) The larger axon conducted the fastest impulses. They can conduct a speed up to 200 mph. The myelin sheath can speed up a conduction through an axon.

Bonus Point(1 point) Explain why you might blush if the person you like asks you to dance?

Because when you get nervous, the sympathetic region transmits to your blood ~~flow~~ to your heart and your heart beats faster and it flushes your face.

Good

**Lesson Log-3/9/04**

**Day #3 Length of Class-83 min**

**What did you expect students to learn during the lesson?** I expected students to be able to trace the pathway of a spinal reflex. I also wanted students to learn that reflexes are involuntary and can occur faster than a reaction because they do not involve the impulse traveling to the brain. I also expected the students to learn that nerve impulses travel in one direction only and respond all or not at all. Students were expected to learn the terms of nerve impulse including threshold stimulus.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** I began class by having the students view "Telegraph Line" which is a short "*Schoolhouse Rock*" cartoon about the functions of the divisions of the nervous system. The class really responded well to this as it was very funny and gave a great summary of the somatic and autonomic nervous system. I displayed an image of a simple spinal reflex on the SmartBoard which showed the structures involved and the direction of the impulse. I then had students volunteer to demonstrate this by having them wear signs that corresponded to the parts of the reflex arc. One student was designated the sensory receptor, sensory neuron, interneuron, motor neuron. When the stimulus reached a demonstrator she was to extend her leg to demonstrate an exaggerated reflex. We used a foam ball to represent the stimulus and impulse as it traveled through the reflex arc. I had the students pass the ball in the correct order to demonstrate the pathway. Then we added an extra step -another student was designated the brain, and I had the students pass the impulse to the brain, who was located far away. This slowed down the whole process and allowed the students to view how including the brain can slow down the response to a stimulus. I asked students how this could have a negative effect if the object of reflexes is to protect the body. We then built a model using dominoes, tape and rulers. Each group of students taped eight dominoes to a ruler so that the dominoes were only attached on one side and they would only be able to fall in the same direction. We used this model to show how dominoes can model nerve impulses which can only travel in one direction along a neuron. Students were challenged to demonstrate stimuli to the dominoes that will not make them fall. Some creative students yelled at the dominoes, even insulted them. While amusing it did show that some stimuli do not result in a response. The dominoes would only fall when enough pressure was applied to a domino on one end to make it fall. I compared this to a threshold

stimulus. Also, because they were taped together along a ruler, when one domino fell they all fell. This illustrated the *all or nothing* nature of neurons. We then modified the model to remove two dominoes to the center. When a stimulus was introduced and the dominoes fell, and the interruption in the chain meant that the remaining dominoes stayed up. I used this to show how an injured nerve tract or spinal cord impulses will travel to the site of the damage and then cannot be transmitted because a physical connection no longer exists.

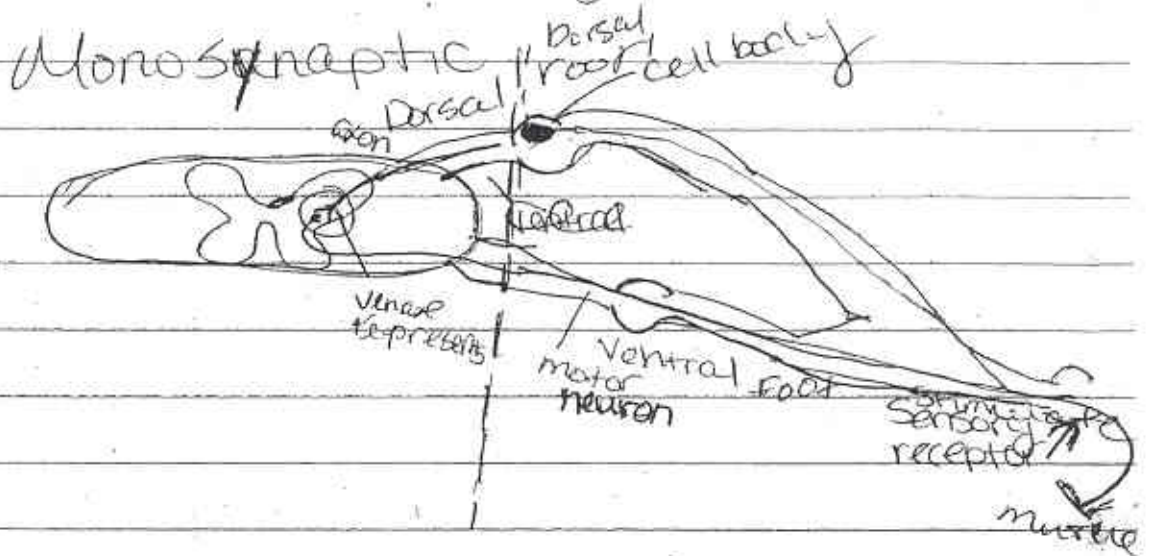
**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.** I asked the students how having every impulse travel to the brain could have a bad effect on homeostasis. One student was able to use an example from the cartoon to explain this. She explained that in the cartoon the cook would have badly burned his hand if he did not react to the hot spoon in time and that the extra time to travel to the brain could have made the burn worse. One of the students explained that he saw the opposite of this in a recent "SpongeBob" cartoon. He described an episode of "Prehistoric SpongeBob" where one of the characters was not as highly evolved as the others and was too stupid to respond to having their hand in the fire. I asked him why he thought that was wrong, and at first he could not respond, so I asked a series of leading questions to get him to state that intelligence is a brain quality, but the brain is not always involved in protective reflexes. This was a teachable moment where I describe the Jendrassik maneuver. This is a way doctors distract the brain which can override reflexes. It allows the doctor to view reflexes which can be affected by people thinking about them.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.** In this case the wrong example provided by the SpongeBob episode led to a teachable moment. I may try to acquire that episode and show it in future classes as an example and use it to contrast with the truth. There was confusion among the students as to how the brain can slow down the response to a stimulus. I reiterated that it is a function of time and distance and that even though our brain can work fast, sending an impulse to it takes time and can slow down our response to the environment. I had the demonstrator students perform the action again and drew attention to how it is the distance to the brain that slows down passing the stimulus. I had the students in the demonstration spread farther apart to mimic the extra distance the impulse has to travel to the brain.

3/9/04

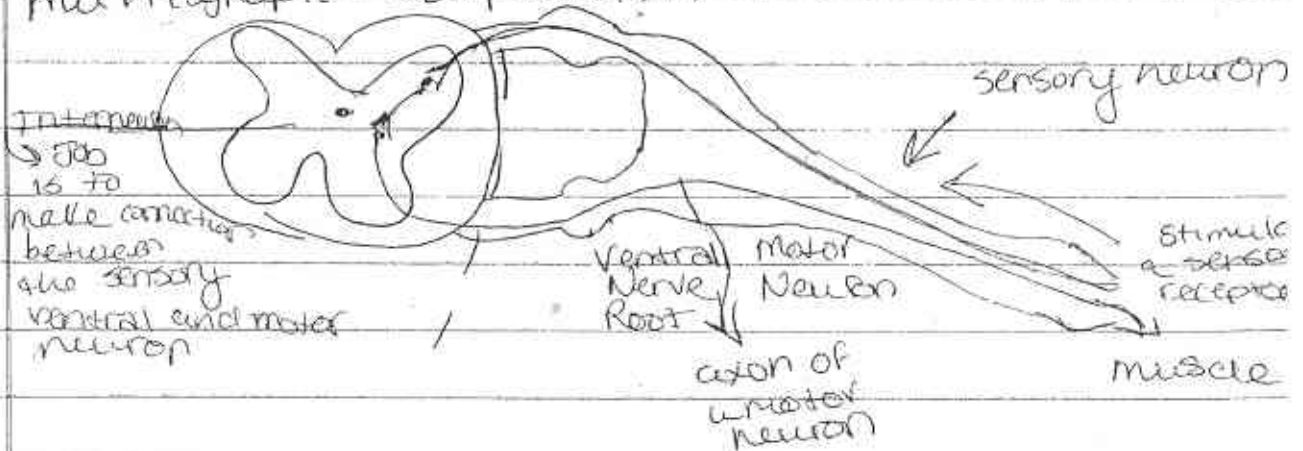
# Biology Notes

## Block 2



ganglion - cluster of neuron of cell bodies

**multi-synaptic Dorsal Root**



**Lesson Log-3/10/04**

**Day #4 Length of Class-83 min**

**What did you expect students to learn during the lesson?** I expected students to differentiate between voluntary and involuntary reactions and how these both serve to allow the person to interact with their environment. A goal for today was to have students summarize the electrical conditions of resting and action potentials. Students needed to understand the role that neurotransmitters play in transmitting nerve impulses across a synapse. Students completed a "skills" lab activity from Lab Manual A that introduced the skills they needed to perform the inquiry lab. Students engaged in an inquiry lab activity which allowed them to observe the nervous system in action and measure reflexes. I expected students to design and conduct an experiment to test one factor that might be involved in affecting reaction time. By the end of class today students began to design and conduct their experiments in fulfillment of the inquiry lab.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** Class began with a review of transport across the cell membrane. The students reviewed the sodium-potassium pump. I asked students what the pump did. Several tried to answer and one was able to correctly recount how the pump is a membrane protein that moves sodium out of the cell and potassium inside. I displayed an image on the SmartBoard of the sodium-potassium pump and how it results in a net charge across the membrane. I had the students pass a lantern battery around while I drew a picture on the board of the battery and its terminals. The twelve-volt battery had a potential difference across the two terminals. I compared this with the SmartBoard image of the potential difference across nerve cell membrane. I had the students view a diagram in their books which shows an axon in both resting and action potential and demonstrates the charges across the membrane of the axon. We defined the terms action and resting potential in terms of what is happening to the axon membrane. At this point I redistributed the domino models and asked students to knock them all down to represent a neuron that has just conducted an impulse. I asked the students if the neuron could now conduct another impulse. Most agreed it could not. I asked the students what now had to happen for the neuron to conduct another impulse. We all agreed that the dominoes would have to be reset. I compared this to the resting membrane potential of an axon. After an action potential has been conducted, the membrane resets due to potassium flowing out of the

cell. I included these on my word wall of important vocabulary terms which I expect the students to learn. Neurotransmitters were covered, but very quickly. I displayed an image on the SmartBoard and identified where the neurotransmitters are found in a neuron. One of my students remarked that the neurotransmitter is like a football being passed.

**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.**

As with all of our classes I monitor student learning by asking questions to insure that students are getting the take home message. The students were quick to think of factors that could affect reaction time. During the pre-lab they indicated which factors they wanted to test during the lab activity. I walked around the room to insure students were safe and not violating the lab rules. All of the students were engaged in collecting the data. Once the inquiry lab was assigned, several student groups had difficulty identifying an experimental problem. I went group to group to assist them in thinking about the differences among the people in this room and realizing that these would be the only test subjects who would be available. This was usually enough to have the students come up with different factors to test for the comparison of reaction times.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.**

Initially I wanted to complete an activity that measures students' reaction time on-line on the "Neuroscience for Kids" website. Once in the computer lab, it became apparent that student computers did not support the activity. This was embarrassing for me, and I found out later that the students' computers have a lot of the multimedia features disabled to keep students from playing games. We returned to the classroom and completed another activity that I had prepared for a class that would not be able to visit the computer lab. This was a lesson I learned during year one, always have a backup plan! The domino models came in handy a second time to explain nerve impulse traveling in one direction only. The skills lab was modified so students did not have to answer the section labeled "Going Further." I wanted them to complete the skills lab quickly so we could get to the inquiry lab during today's class. I realized that I had planned to cover too much material in this unit. I will have to elaborate on neurotransmitters following this unit which will coordinate with neuromuscular junction. One of the problems encountered during the lab was that there are only three boys in this class and one was absent. Those groups that wanted to test boys' vs. girls' reaction time were limited in test subjects. I told them to proceed and to mention it in the



lab write-up. One lab group wanted to test reflexes and reaction time before and after lunch so I arranged it with their next block instructor to have them come back to class and finish collecting their data.

## Chapter 35 Nervous System

## Observing Nervous Responses

17

## Introduction

The nervous system is a series of conducting tissues that carries impulses to all parts of the body. Your nervous system initiates many types of reflex actions. When you touch a hot object, you immediately pull your hand away. You might be aware of this reflex action occurring, but you are unable to stop or control it.

How do reflex actions occur? When your hand touches a hot object, for example, heat receptors in the skin send an impulse to the muscles of the arm to contract. The impulse travels along the sensory neurons, to the spinal cord, across a synapse, and stimulates a motor neuron. The impulse leaves the spinal cord, passes back to the same nerve, and back to the arm muscles, causing them to contract and pull your hand away. This pathway is called the reflex arc. Because the reflex arc involves only the spinal cord and not the brain, a reflex action occurs in a matter of a fraction of a second, you are not able to control a reflex—it happens automatically.

In a nonreflex response, an impulse must travel to the brain. The brain interprets the stimulus and initiates an appropriate response. In this case, the time it takes to respond is measurably longer than the time required for a reflex arc. A person's reaction time can be measured by how quickly he or she can perceive a stimulus and then react to it. Driving a car and playing tennis are examples of activities in which reaction time is very important.

In this investigation, you will observe two reflex actions and measure your reaction time.

## Problem

Can you control reflex actions? How can you measure reaction time?

## Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. What data will you record in Data Table 2?

Record in centimeters the position of your thumb and index finger. This is the distance the meter stick fell before you caught it.

2. What is another name for an involuntary or automatic response to a stimulus?

A reflex

3. What caution should you observe for shining the light?

The caution of not ~~aiming~~ shining the light directly into the persons eyes

Good point

4. Why do you put your elbow on the table when you are catching the meter stick?

You put your elbow on the table when you are catching the meter stick because you want to be able to move your elbow down when you go to catch the meter stick.

5. In Part A, why do you use an eyepatch instead of just closing your eye?

So you could directly cover up the eye from the light because if you didn't it might affect the experiment.

### Materials (per group)

pen light  
eye patch or eye cover  
meter stick


### Safety

This experiment involves physical contact. Avoid this experiment if a problem with the knee, eye, or hand exists. Note the safety alert symbol next to step 3 in the Procedure and review the meaning of the symbol by referring to Safety Symbols on page 8.

### Procedure

#### Part A. Reflexes

1. Sit on a chair or stool.
2. Cross your left leg over your right.

-  3. Have a member of your group tap your knee firmly, slightly below the knee cap, with the side of his or her hand, as shown in Figure 1.  
**CAUTION:** Be sure the knee is not hit hard. A firm, quick tap is sufficient. Avoid this experiment if a physical problem in the knee exists. Record your observations.

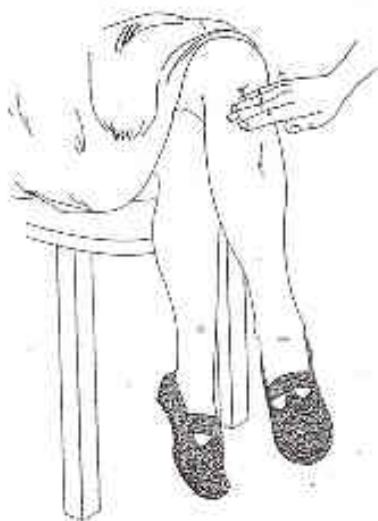


Figure 1

Name \_\_\_\_\_

Date \_\_\_\_\_

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4. Repeat steps 1 to 3. This time, try to stop your knee from jerking. Record your observations.
5. Reverse roles and repeat steps 1 to 4.
6. Sit on a chair or stool.
7. Close one eye and cover it with the eye patch. Keep the other eye open.
8. Have a group member shine the pen light close to the open eye for about 10 seconds. **CAUTION:** Do not shine light directly into the eye.
9. Quickly remove the patch from the other eye.
10. Have a group member observe what happens to the pupils of both the eye exposed to light and the eye that remained in darkness. Record the observations in Data Table 1.

Data Table 1

Stimulus	Observations
Light	The pupil of the eye that was in the light got smaller.
Dark	In the dark the pupil remained the same, but looked way bigger than the one in the light.

11. Reversing your roles, repeat steps 6 to 10.

### Part B. Reaction Time

1. Rest your elbow on a table and extend your arm over its side as shown in Figure 2.

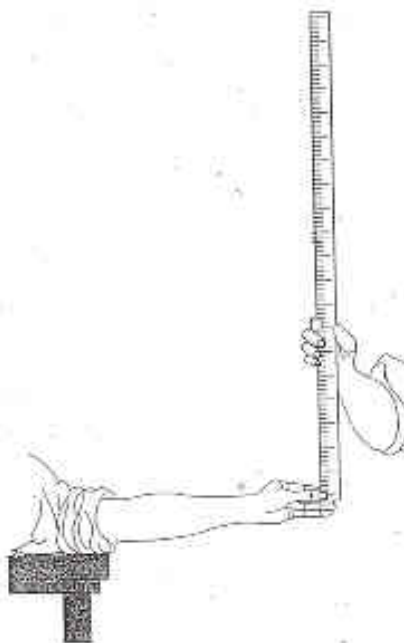


Figure 2



- Have a group member hold a meter stick in the air, with the 0-cm line between the thumb and index finger of your extended hand.
- Have the group member drop the meter stick without advance notice. Try to catch it between your thumb and index finger as quickly as possible.
- In Data Table 2, record in centimeters the position of your thumb and index finger. This is the distance the meter stick fell before you caught it.
- Repeat steps 2 to 4 three times.

Data Table 2

Trial	Distance (cm)
1	7cm
2	26cm
3	7cm
4	10cm

A STUDENT'S NAME WAS HERE

### Analysis and Conclusions

- Observing** What happened to your knee when it was tapped?  
 I got a little reaction in the left knee but I got no reaction at all in the right. So for my right leg I did a little trick where I put my hands together. then when I felt the hammer hit my knee I would pull my hands apart.
- Inferring** Could you prevent the knee jerk or the pupil contraction?  
 Explain your answer.  
 I think in some ways I could prevent the knee jerk if I thought about stopping my knee from moving because my brain would over-ride what my knee would do because you can control your knee from your brain, but you can't control the pupil contraction. I couldn't because there's no way to control how the iris of your eye is going to work. Your brain doesn't control that.
- Observing** What happened to the pupil of the eye that was close to the light?  
 The pupil got a lot smaller.
- Inferring** How does the amount of light affect the pupils?  
 When there's more light the pupil tends to get smaller while, when there was less light the pupils remains the same, or doesn't get that small.
- Classifying** Is catching the meter stick a voluntary reaction or a reflex? Explain your answer.  
 It's a voluntary reaction because you have to think about catching the meter stick through both your pointer and index finger, it's not just something that would happen automatically.
- Calculating** What was the average distance the meter stick fell in your four trials?  
 My average distance was 39.75 cm

This is called the knee jerk reflex

Name \_\_\_\_\_

Date \_\_\_\_\_

21

7. **Comparing and Contrasting** In catching the meter stick, were your reactions faster or slower than those of your classmates? How do you know?

My reactions were slower than most of my classmates. I know because I was going around and seeing everyone else's reaction times and mine seemed to be one of the slowest.

8. **Classifying** From your observations, how would you classify the knee-jerk and the pupillary response? Explain your reason.

I would explain the knee-jerk as a voluntary reaction because it can be controlled by your brain in a way and the pupillary response is a reflex because there's no way you can control your brain how big or small your pupil gets.

9. **Drawing Conclusions** Suggest some possible ways that reflex arcs could be advantageous to a species.

Take for instance animals, if they didn't have reflex arcs then they wouldn't be able to escape danger or they wouldn't be able to go after their food. With our reflexes they are able to survive out in the wild.

### Going Further

Do the senses of sight, smell, hearing, taste, and touch also affect our reflex actions? Why does your mouth water when you are hungry and see a picture of a delicious meal? Ivan Pavlov, a Russian biologist, carried out many experiments on conditioned reflexes. What are conditioned reflexes? How are stimulus and response related? Use resources in your school library or on the Internet to find out more about conditioned reflexes. Share your findings with the class.

→ Actually knee jerk and pupillary response are involuntary. Both serve to protect you, without having to "think" about it.

**Lesson Log-3/11/04**

**Day #5 Length of Class-46 min**

**What did you expect students to learn during the lesson?** During this shortened class (professional development day) I expected the students who had not yet completed their data collection for the inquiry activity to do so. This was necessary so we could examine each lab group's data and results and identify common findings. I wanted the students to come to the conclusion that reaction time can indeed be affected by a variety of factors. I expected that students would come to the conclusion that observation of reaction time involved processing some stimulus through the brain, and that because of the extra steps, this would take longer. I expected students to correctly identify the dependent and independent variables in their experiments. I also wanted them to identify some of the variables they had to control in their experiment.

Students read a sample from the Merck Manual of Geriatrics which deals with reaction time and the elderly. We also explored the issue of reaction time and driving. One of the major risk factors for spinal cord injury is motor vehicle collision among younger people. From what I have observed in this school there is a definite "Fast and Furious" car culture that encourages unsafe driving. Instead of having the students read yet another scare tactic handout they looked at people at the other end of the life spectrum and saw from the graphs just how unsafe teen drivers were as a whole.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** Class began quickly as students read the sample from the Merck manual. Two graphs were included, and I wanted students to extract information from the graphs to answer a question set at the beginning of class. After a few minutes of quiet work, students participated by answering the questions aloud for participation points. Answers to the questions were clarified, and I displayed the graphs that the students had in front of them on an overhead. The large spike representing accidents at the teenage groups was fairly obvious. From here a couple of students had to complete the lab activity, and I allowed the lab groups to examine their findings before we discussed the results. As part of their grade for the lab, students had to describe their findings to the class. This went quickly as students explained their findings for the lab. Because the students' experiments were varied, analyzing data for commonality was not really helpful. It was better to describe the data in terms of how reaction times changed in

response to changes in the independent variables. I asked the students what their conclusions were, and how valid their data was. With few exceptions most students realized that an experiment that tests only a few trials or subjects has inherent flaws.

**Describe how you monitored students' learning and what you found about their**

**understanding of the lesson's main concepts.** Overall the students did a good job identifying the variables and using the CAPT terminology of dependent and independent variables. Virtually all the groups stated that their data has problems in that they used small sample sizes and a similar population. I asked the question how you could improve your experiment without changing the methods. One student who compared reaction time of boys versus girls quickly stated he would like to test as many people in the school as possible. I asked the class if this was a good idea and they agreed. The students clearly recognized that sample size plays an important role in experimental validity. An issue that came up was variables that needed to be controlled in the experiment. We made a list on the board of some of the variables that had to be controlled. Factors identified by the students included: the height of the ruler drop must remain the same, the person dropping the ruler must be the same every time and the arm of the test subject must be isolated on a desk. Most groups were able to observe some variance in reaction time as a result of their experiment. It was also important that reflexes were mostly observed as unchanging. It was interesting to see just how varied the independent variables were. Some students were concerned that arm length could affect reaction time as it provides a longer pathway for the impulse to travel. Other students investigated height, gender or whether the student participated in sports or video games.

**Describe the instructional adjustments you made in response to your findings about**

**students' learning needs during the lesson.** During the analysis of the bell-work, the discussion of the large number of accidents started to become kind of preachy. Some of my students recently got their learner permits and said things like: "You are starting to sound like my parents." I steered the discussion back to reaction time and focused the students on the fact that reaction time does change with age. The discussion of the lab results showed that several students were having trouble grasping the concepts of dependent and independent variables. At this point in their high school career, students need to nail down those terms so that it does not come back to haunt them in the CAPT. I used time to clarify those terms in the context of their inquiry lab. The data was shared by having the students state their findings for the class.



Bellwork (5 points)

5/5

1. According to the graph provided with the sample, which age group has the highest rate of motor vehicle collisions overall?

The ~~graph~~ group ~~that~~ has the highest rate of motor vehicles is the teenager.

2. Are the elderly responsible for a larger number of collisions?

No they are not responsible for a larger amount of collisions

3. List some reasons why elderly drivers are involved in fewer collisions than younger drivers?

They drive slower

they are more cautious

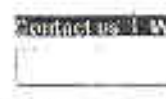
they don't ~~come~~ drive during traffic hours

4. Where on the road are elderly drivers more likely to have a collision? They are more likely to have a collision ~~in~~ <sup>in an</sup> intersection.

5. Explain what happens to reaction time as you age?

As you age your reaction time slows ~~down~~ and becomes

Why does it slow down?  
Because of Neuron loss!

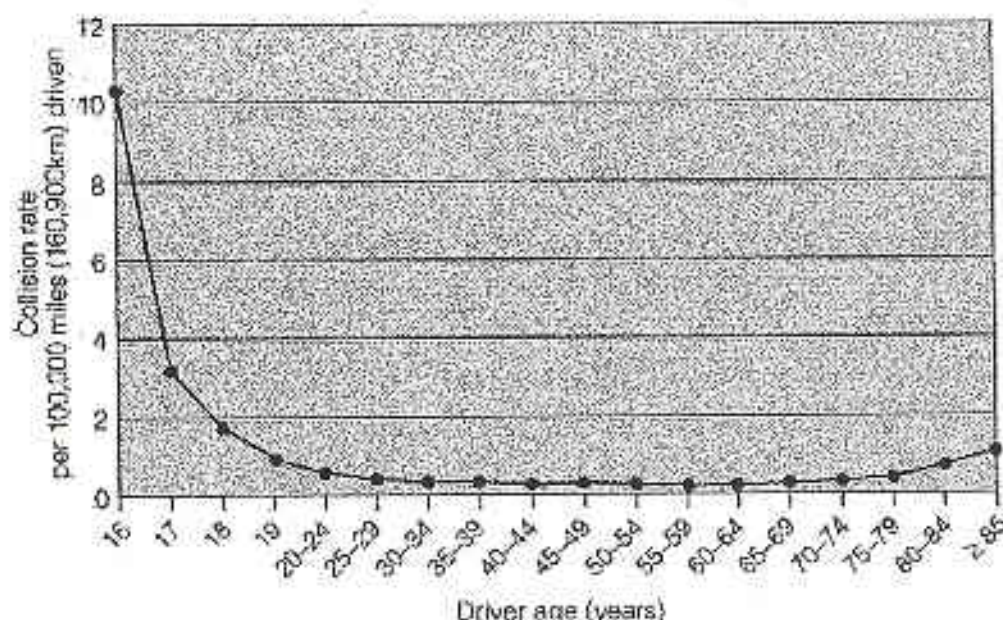


## The Merck Manual of Geriatrics

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### Section 2. Falls, Fractures, and Injury

## Chapter 23. The Elderly Driver



**FIGURE 23-2.** Motor vehicle collision rates per 100,000 miles (160,900 km) driven, according to age. From Cerelli EC. *Crash data and rates for age-sex groups of drivers, 1994*. Research Note. National Highway Traffic Safety Administration Technical Report, October 1995.



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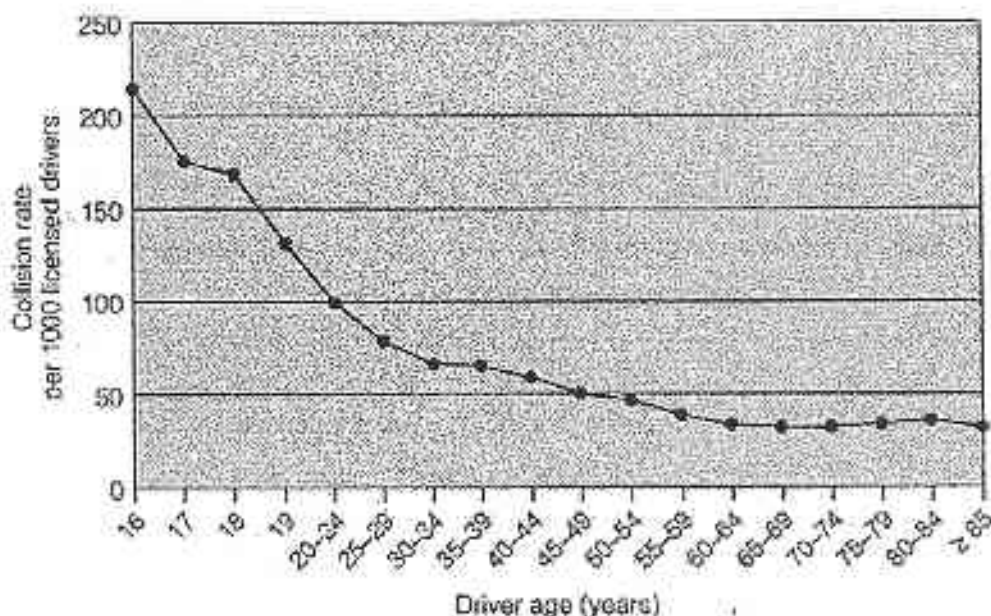
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### Section 2. Falls, Fractures, and Injury

## Chapter 23. The Elderly Driver



**FIGURE 23-1.** Motor vehicle collision rates per 1000 licensed drivers, according to age. From Cerrelli EC. *Crash data and rates for age-sex groups of drivers, 1994*. Research Note. National Highway Traffic Safety Administration Technical Report, October 1995.





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## The Merck Manual of Geriatrics

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### Section 2. Falls, Fractures, and Injury

this section includes

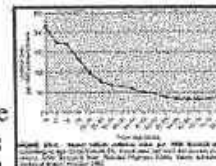
Chapter 18. Syncope | Chapter 19. Chronic Dizziness and Postural Instability | Chapter 20. Falls | Chapter 21. Gait Disorders | Chapter 22. Fractures | Chapter 23. The Elderly Driver

## Chapter 23. The Elderly Driver

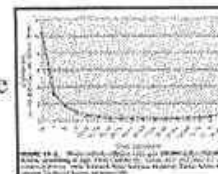
For most community-dwelling elderly persons, being able to drive is essential for maintaining autonomy in daily activities (eg, shopping, medical appointments, social visits church functions). For elderly persons who cannot drive, alternative transportation should be arranged, although such arrangements often involve dependence on family members and friends. The use of public transportation, even if available, is often unacceptable because of inconvenience, cost, or concerns about safety.

Safe driving requires the integration of complex motor, visual, and cognitive tasks, although many drivers with moderate motor, visual, and cognitive deficits can continue to drive safely, probably because these tasks have been consolidated into a learned, instinctive pattern of driving. Performance is usually affected only after considerable loss of function.

To compensate for moderate functional deficits, most elderly persons avoid rush hour and drive fewer miles, shorter distances, and less at night. For instance, average mileage is 64% less for 85-year-old male drivers than for 65-year-old male drivers. Elderly drivers are also more cautious than younger drivers, drive more slowly, and take fewer risks in traffic. Because elderly persons drive less than younger persons and because they are more cautious, they have fewer collisions. Collision rates (per 1000 licensed drivers) decrease steadily with age (see Figure 23-1). Thus, it is a myth that elderly drivers are responsible for a disproportionate number of motor vehicle collisions.



However, per mile driven, elderly drivers have higher rates of traffic violations, collisions, and fatalities than all age groups over age 25. Collision rates per mile driven increase after about age 70 and increase more rapidly after age 80 (see Figure 23-2). Failure to yield right-of-way and failure to heed a stop sign or red light are the most common violations. Furthermore, elderly drivers have a higher proportion of collisions at intersections. These findings imply that some elderly drivers have difficulty with driving tasks requiring complex decision making.



Elderly drivers involved in collisions fare worse than younger drivers. Collisions involving elderly drivers are more likely to include multiple vehicles and to result in serious injuries and fatalities, partially because the elderly have different driving patterns and because they

Post Lab Discussion (14 points)

11/14

3/11/24

1. What were some of the variables you tried to control in your experiment? (2 points)

+2 height of the meter stick  
the technique  
also the exercising time

2. Did any of the other lab groups have the same controls? What were some of the controls that you had in common with other lab groups? (2 points)

+1 The height of the meter stick

- +2 3. What were you trying to measure in this experiment? (2 points)

In the experiment we were trying to measure and compare the reaction time and reflex from an athletic and a non athletic person

4. Identify the dependent (responding) variable in your experiment? (2 points)

+1 The ~~exercising~~ reaction time, and the reflex after and before exercise  
What reflex did you observe?

The independent was the exercises

5. Identify the independent (manipulated) variable(s) in your experiment? (2 points)

+2 exercises: and time  
"Athletic" vs "non-Athletic" makes no makes

6. Explain how poor technique in dropping the meter stick could have affected the reaction time data? (2 points)

+ 2 The poor technique in dropping the meter stick because it might speed it up or slow it.

7. How would you improve, refine or take your experiment further? (2 points)

+ 2 I would improve by using more samples.

**Lesson Log-3/12/04**

**Day #6 Length of Class-83 min.**

**What did you expect students to learn during the lesson?** I expected the students to present their findings from the STS activity assigned last week in fulfillment of the requirements of their project. I expected students to share their views and weigh in on the subjects presented in class. Students had an opportunity to express their opinions on the subject investigated and the possibility of changing their views based on what was presented in class. I expected students to have a deeper understanding of what Embryonic Stem Cells are and how could they be used to heal spinal cord injuries. Students had an opportunity to learn from their fellow students about technology like Functional Electrical Stimulation used to assist injured persons. This was demonstrated in a videotape at the beginning of the unit and made an impression on some students, especially those interested in physical therapy careers. I expected students to recognize that all medical technology comes at a huge cost and has limitations. I arranged to have the school nurse loan us a wheelchair to have the students try to perform various school related tasks from a wheelchair. I wanted the students to examine the school and see if it is truly "accessible."

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** As part of their requirements for the inquiry lab students had to describe their major findings for the class. I had students alternate their presentations. For example I had a student who completed a report on stem cells follow a student who investigated FES. This prevented students from tuning out the following material which was at times repetitive. For those students who had completed PowerPoint projects I allowed them more time than the five minutes and provided them the use of the SmartBoard for their presentation. I had students complete a short set of questions at the end of class for a couple of reasons. I wanted to allow the shy students to have another forum to tell me their opinions on the subjects presented today.

**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.** I have to admit that I considered this class a close knit community of learners, partially because of the small size, and partly because it is mostly female. But what I heard in class surprised me. These students were passionate about this issue from very different viewpoints. I have deeply religious students who consider human embryonic stem cell research to be akin to murder, and they were more in favor of treatment regimes that were similar to Functional Electrical Stimulation. I had a student, and I was unaware of this before, who had a close family member who suffered a spinal cord injury from



street violence. She was strong advocate for stem cell research no matter what the cost. Ironically, I know these girls are friends. What pleased me is that they shared these views in our classroom setting without hesitation. Reviewing the student responses to the post STS questions I distributed in class, I found that students used examples from other students' projects in their answers. This was clear evidence that they were able to learn from each other. For example, one student was able to offer that stem cells can be found in umbilical tissue, and this might be a better solution than using embryonic stem cells.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.** Students had to present their findings to the class, but much of what they found was very similar. It quickly became repetitive. There was a presentation in which one of the students made the statement that all kinds of diseases could be "cured" by using stem cells. This misconception had to be addressed immediately. I instructed the students that while stem cells show amazing promise, the use of them has not cured any diseases yet, and major technical problems have come up with using them and will continue to come up. I was pleased when a student added that stem cells are difficult to get from adults, and to get them from human embryos is allowed only on a limited basis. She also added that sometimes, when using them, they get trapped in scar tissue and do not always reconnect injured spinal cord tissue. One thing I noted is that while the students presented their findings they were less likely to describe their point of view on the issues. Perhaps this was a comfort issue. It's safer and easier to speak your mind while sitting behind a desk than in front of the class. I didn't force any student to weigh in on the controversy surrounding stem cells or FES while in front of the class, but most gave their opinions anyway. Once all the students who had completed the project presented, I asked the students to consider hypothetical situations to spark discussion. For example, I suggested the government might be willing to fund stem cell research and/or FES for every patient as long as they were not injured as a result of a crime (including speeding, drunk driving). Most students were able to say that it is almost impossible to do that because, if the government began spending money on this, then people have the right to have it available to everyone. I asked the student to discuss how President Bush's views on stem cells could possibly be affected by a personal tragedy. This sparked discussion over individual rights versus a societies' responsibility to pay for it.



GOOD JOB  
TODAY

Biology  
Block 2

32

## Spinal Cord Injuries and Society

Thank you  
for sharing your  
viewpoints!

1. List and describe three (or more!) topics investigated by your classmates that you found interesting, informative or complimentary to what you investigated.

- stem cells can be extracted from the nose rather than a fetus
- stem cells are controversial because research needs a fetus and it's almost like killing a baby
- A million dollars worth of money that is need per lifetime to treat a person w/ SCI.

2. Do you think spinal cord injuries more of a problem for the individual living with the injury or for society as a whole? Explain?

I think SCI is a problem for both a individual and society because an individual has to pay \$1 billion a lifetime to treat SCI and society's tax rates may increase if they want to have treatment for and insurance SCI be free for the injured.

3. How do you feel about the use of material from human embryos to possibly help injured spinal cord heal? Does this go against your personal beliefs?

I don't feel it right to use a human embryo, but to use other places like the nose to get the cells. I feel that if they use something else to get the cells, I would support it. The use of human embryos is against my belief but if they got the cells from other places like the nose it would not be against my beliefs.

4. Imagine that you are allowed to decide where all of the research funding (\$) gets spent in spinal cord injury research. If you only had two choices, one being to fund the development of assistive technology, such as access technology (Wheelchairs, FES, integrated electronics to help a person stay independent, etc). The second choice is to fund stem cell research. How would you divide up the money and why?

I would divide the money half and half because I would like to repair SCI rather than assist the people w/ SCI and use stem cells. But if stem cells don't work then we will still have money to research FES.

**Lesson Log-3/15/04**

**Day #7 Length of Class-83min**

**What did you expect students to learn during the lesson?** I expected students to display their knowledge of the nervous system, spinal cord and PNS by completing the assessment quiz with a class wide 80% average. I also expected the students to have unit concepts reinforced by this assessment. Although this block was 83 minutes, I allotted 50 minutes for the test to complete the unit within the time limit. Following the quiz, I allowed the remaining couple of students who had not turned in their STS project to present their reports to the class to reinforce the concepts learned through the STS project.

**Describe the learning activities and the use of resources to support students' learning of the lessons' main concept and/or processes.** Students took a test which was involved and comprehensive covering the topics from the previous classes. Included on this test were several types of questions both closed and open-ended. I did include questions which dealt with topics covered before this unit as I do on all formal assessments. This encouraged students to review "old" concepts and to see how they relate to the current ones being studied. I was pleased to see the performance on those questions was outstanding. This test included MRI images of real patients for which students were asked to identify the spinal cord and the disks that were impinging on it.

**Describe how you monitored students' learning and what you found about their understanding of the lesson's main concepts.** Considering the amount of material I asked my student to absorb in such a short time the outcome was acceptable. The class average was just below an 80%. Often the average is slightly higher for similar assessments. There were several questions that the class performed poorly on. Questions 25 and 26 which dealt with membrane potential and had associated diagrams gave many of the students problems. I feel this was due to two things. I did not emphasize this topic with the same depth that I covered other aspects of this unit, and the diagrams with the questions were hard to read.

**Describe the instructional adjustments you made in response to your findings about students' learning needs during the lesson.** One adjustment to traditional multiple-choice testing that I used was to allow students to narrow down an answer from the distracters. They did this by crossing out the wrong answers, putting a star next to their second choice, and placing their best choice on the line. If their final answer was wrong I checked to see if their

second choice was starred which would result in partial credit. Not all students took advantage of this, but it lowered the intimidation factor involved when the answer did not come quickly, and it discouraged guessing. Rather than penalize students for my poorly selected questions I chose to throw them out and added points to the score across the board. There were other problems with this assessment tool that will have to be addressed for future classes. I will include a section that is more similar to the CAPT and asks students direct questions that deal with the lab activity. Also, the use of a more realistic cross section of the spinal cord caused confusion to some students who probably would have done better using a more diagrammatic picture. I had used this in class during instruction, but it did not copy well for the test. I usually collect late homework only to check for understanding and not for grade, but because of the amount of work that I required the students to do in this unit, I did today. I did this because I wanted to allow them to learn from the assignments that they may have skipped simply to finish the STS project. One thing student had trouble with was the MRJ image. It did not copy well and I had blocked an area out so students could write their answer. A lot of students were confused by the MRI and asked me what "the big white thing is." I had to explain to the class that it was simply a blocked out area for them to write their answer.

# SPINAL CORD AND REFLEX ACT

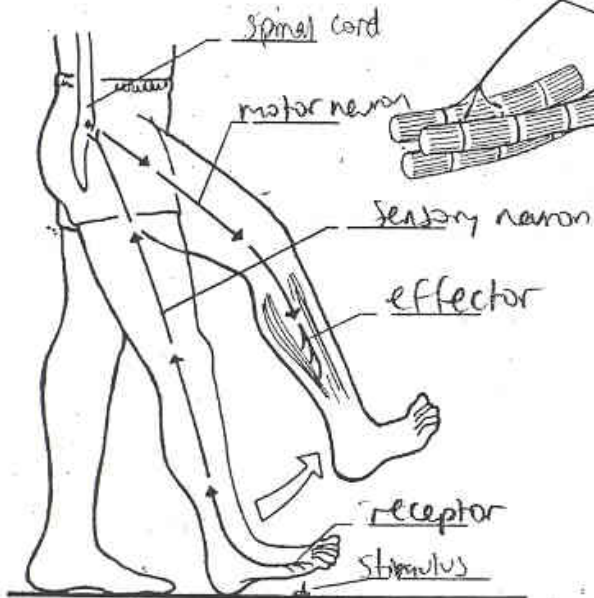
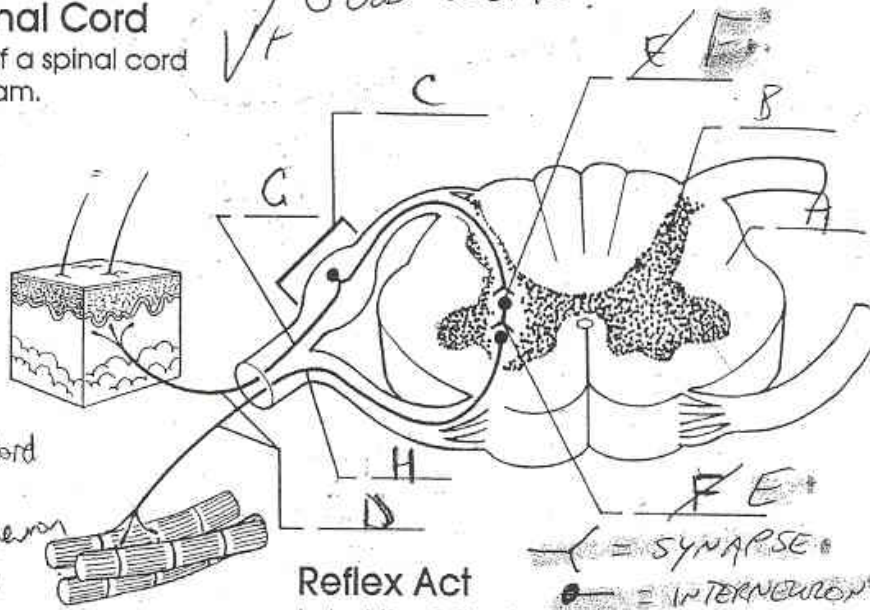
NAME \_\_\_\_\_

36

## Cross Section of Spinal Cord

Label the following parts of a spinal cord on the cross-section diagram.

- a. white matter
- b. grey matter
- c. dorsal root ganglion
- d. nerve fibers
- e. Interneuron
- f. synapse
- g. sensory neuron
- h. motor neuron



## Reflex Act

Label the following parts of a reflex act on the diagram of a boy stepping on a tack and jerking his leg away.

- a. sensory neuron
- b. motor neuron
- c. stimulus
- d. spinal cord
- e. receptor (in skin)
- f. effector (muscle)

Fill in the blanks with the correct answers.

Suppose you stepped on a tack. You jerked your leg away because <sup>or before</sup> you were aware of what happened. The impulse traveled from the receptor, the skin, along a(an) sensory neuron into the spinal cord. The impulse jumped across a(an) interneuron to a(an) synapse; then across another synapse to a motor neuron. The impulse traveled along this nerve to a muscle, effector, in your leg. You jerked your leg away. Only a fraction of a second later, a(an) impulse traveled up your spinal cord to your brain. But you had involuntarily reacted. This kind of reaction is known as a(an) reflex. Reflex acts occur without thinking.



# I. Observing Nervous System Responses

STUDENT #1

March 11, 2004

## II. Problem: Does gender affect reflex and reaction time?

We define reaction time as how many cm the thumb and the index finger are when the subject caught the meter stick.

## III. Materials: meter stick, reflex hammer, safety goggles, chair, table

## IV. Procedure (reflex):

- 1) Put on safety goggles.
- 2) Sit on a chair.
- 3) Ask the subject for permission to do the procedure and ask about any recent injuries.
- 4) Tell the subject to turn their face away, close their eyes, and relax.
- 5) Find the tendon under the knee with your thumb and gently tap your thumb with the reflex hammer. Watch closely for any slight reflexes.
- 6) Repeat step 5 four times and have the person or subject use the Jendrassik's maneuver if necessary.
- 7) Record data in a table.

## V. Procedure (action time):

- 1) Have subject elbow on a table and extend their arm over the table's side.
- 2) Have a group member hold the meter stick in the air, with the 0-cm line between the thumb and index finger of the subjects' extended hand.
- 3) Drop the meter stick without advance notice. Have the subject try to catch it between their thumb and index finger as quickly as possible.
- 4) Record data in cm's the position of the thumb and index finger.
- 5) Repeat steps 2 to 4 three times and record your data.
- 6) Average out the subjects' reaction time.
- 7) Record data.

## VI. Results: Reaction Time

Trials	Female (cm)	Male (cm)
1	19 (.20 sec)	10 (.14 sec)
2	9 ½ (.14 sec)	18 (.19 sec)
3	17 (.19 sec)	11 (.15 sec)
4	15 (.17 sec)	11 (.15 sec)
Average	15 cm (.17 sec)	13cm (.16 sec)

## Reflexes- Eyes

Stimulus Observations	What happened to the pupils
Light (male)	Pupils got smaller
Dark (male)	Pupils got larger
Light (female)	Pupils got smaller
Dark (female)	Pupils got larger

STUDENT #1

**Reflexes- Knee Jerk**

Gender	Reflexes
Male	Leg slightly moved
Female	Leg slightly moved

**VII. Conclusion:**

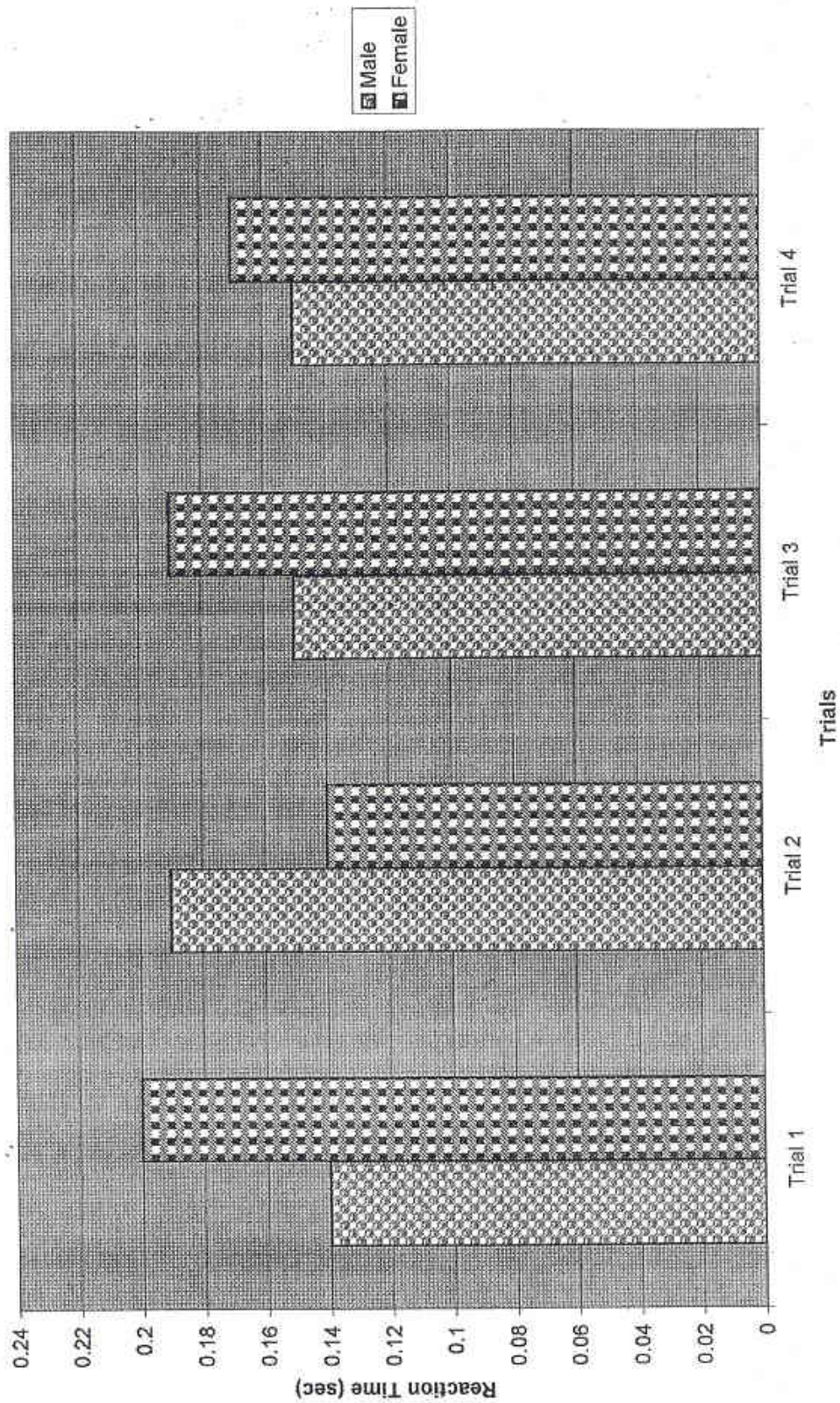
It turns out that males have slightly faster reflexes than females, but this data can't be depended on because we only tested one male and one female. We believe that if there were more test subjects the results would be more reliable. This experiment could be taken further by testing variables of various females vs. various males, male athletes vs. female athletes, and so forth.



STUDENT #1

39

Reaction Times Male vs. Female



59/55

GOOD JOB!

STUDENT #1  
39B  
71

### Grading Rubric (55 points total)

Possible Points      your response required for maximum points

10	10 points	Lab report completed on time and neat. <u>Late labs lose ten points per day.</u> Lab due Monday March 15
5	5 points	Appropriate <u>Title</u> and <u>headings</u> (Parts I-VI) (all underlined) Include name and date.
10	10 points	Clearly stated <u>Problem</u> . What was the lab designed to test or measure? Does it consider both reflexes and reaction time?
10	10 points	Clearly written or outlined <u>procedure</u> and list of <u>materials</u> . Are both reflexes and reaction times tested?
5	5 points	Clear presentation of <u>results</u> , including <u>tables</u> , and a <u>graph to displaying reaction time</u> vs. your independent variable. Reaction time is calculated using $y=1/2gt^2$
6	10 points	Clearly stated conclusions about your data and how it relates the problem. <i>This would be developed</i>
5	5 points	<i>BETTER</i> Sharing experimental design and data with the class.
+5	As always if lab report is typed (Arial size 12) you will receive 5 bonus points.	
+3	If graph of reaction time vs. the independent variables is produced using Excel you will receive 3 bonus points.	

Calculating reaction time from raw data will be completed with Mr. Math section. Therefore you do not need to include it in your report.

in your



STUDENT #1

March 10, 2004

## Investigation on Stem Cell Research

It is estimated that the annual incidence of spinal cord injury (SCI), not including those who die at the scene of the accident, is approximately 40 cases per million population in the U.S. or approximately 11,000 new cases each year. Since there have not been any overall studies of SCI in the U.S. since the 1970's it is not known if incidence has changed in recent years.

The neurons that make up the spinal cord have extensions, called axons, that resemble telephone wires and carry messages between the brain and the rest of the body. Traumatic injury can kill neurons or interrupt the axon connections, causing a loss of function- resulting SCI.

Good description of what stem cells are

There has been a proposed solution in repairing spinal cord injury; stem cells. In stem cell research, the researchers used embryonic stem cells which have the potential to become any cell type in the body depending on what chemical signals they get when they mature. The researchers hoped that by triggering embryonic stem cells to become nerve cells precursors and then transplanting these precursor cells into the injured area they could promote healing of the spinal cord.

In this study researchers have used rats as test subjects. The researchers treated rats nine days after an injury to the spinal cord by transplanting cells from mice into the injury site. In an other control group, the rats underwent a fake operation and were given only the culture medium

with no cells. Two to five weeks following the procedure, the researchers found various markers that showed the transplanted cells were alive and functioning. They also used techniques to identify any axons that had grown from the transplanted cells. At two weeks, transplanted cells had not only filled the cavity at the point of injury, but had migrated up to 1 cm in each direction. By the five week follow-up, the cells were not as dense, but the injured regions still contained mouse axons. None of the cells had developed into tumors. Although, strategies including stem cell transplantation may some day be used to treat paralysis after spinal cord injury the biggest issue of all may be that human motor behavior is more complicated. Even if cells grow, it does not mean they will work. Also, in the real world, you often have to contend with blood, scarring, and <sup>good point</sup> other problems that were not mimicked in this model.

Among those who support embryonic stem cell research Christopher Reeves, paralyzed from the neck down, when he was thrown from his horse, is supporting a bill that would support therapeutic cloning. Celebrities have, also, been very much involved in the campaign for stem cell research in the U.S. including Michael J. Fox arguing on behalf of Parkinson's Disease research, and Mary Tyler Moore, making the case for diabetes research. As for those against stem cell research, the Bush administration caved in on the issue of embryonic stem cell research after the Catholic church expressed opposition to cloning.

Where did you find this  
What do you mean by "caved in"  
And what would he in response to a church group  
This should be typed

my.webmd.com/content/article...  
www.spinalcord.uab.edu

Spinal Cord Injuries and Society

Scoring Sheet

STUDENT #1

For Full credit:

- 10 10 points Work submitted on time. When class time was given to work on project student used the time effectively.
- 10 15 points Project follows guidelines stated in Rubric  
-2 POINT CHOICE -5 writing lacks transitions  
-1 not completely typed
- 20 20 points Description of technology either in use or in development that is designed to help those with spinal cord injuries. Did you answer this question, how does this treatment work to repair damage or assist in mobility? You correctly stated that stem cells can become nerve cells!
- 20 20 points The student described in detail some of the challenges that using this technology presents. You mentioned surgery, death, AND the fact that the human body is complex
- 10 20 points The student fully identified any Bioethical controversy surrounding the use of the chosen technology and its applications. Student elaborated and included examples of those who are for and against the use of the treatment. You included who is for and against but not why they feel that way they do!
- 15 15 points Class presentation and participation in discussion. You relayed the topic you investigated to the class and any new treatment that you thought might be effective to treat spinal cord injuries and why. You answered the closing questions in full. You were attentive and respectful of differing opinions presented in class.

Total possible points: 100

Your Score

82

Student name:

I was impressed that you offered the nerve insight about stem cells that can come from NASAL neurons. Why did you not include this in the paper?



Name:

Class:

Block 2

Date:

3-15-04

ID: A

142

## Spinal Cord and PNS

True/False

(1 point each)

Indicate whether the sentence or statement is true or false.

82/100

85/100

Excellent!

42

- T 1. The elongated extension of a neuron that receives impulses from the cell body is called an axon.
- T 2. The basic unit of the nervous system is the nerve cell, or neuron.
- T 3. The peripheral nervous system carries all the messages back and forth between the central nervous system and the rest of the body.
- T 4. A spinal reflex is an involuntary response that requires the spinal cord but not the brain.
- F 5. In some neurons, a form of supporting cell called a myelin sheath wraps around the axon.
- F 6. Myelin sheaths slow down nerve impulses by forcing them to jump from node to node.
- F 7. The inside of a resting neuron has a positive charge.
- T 8. Neurons communicate with other cells by sending neurotransmitters across synapses.
- T 9. Neurotransmitters are chemical messengers that carry nerve impulses across the synapse.

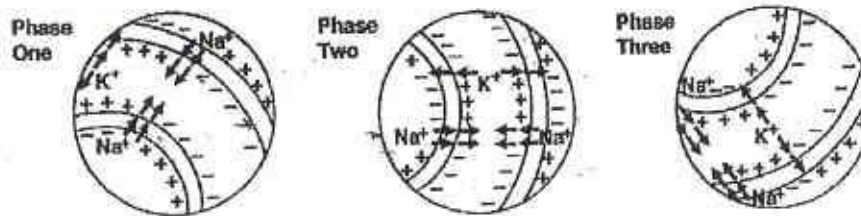
## Multiple Choice

(2 points each use deductive reasoning process)

Identify the letter of the choice that best completes the statement or answers the question.

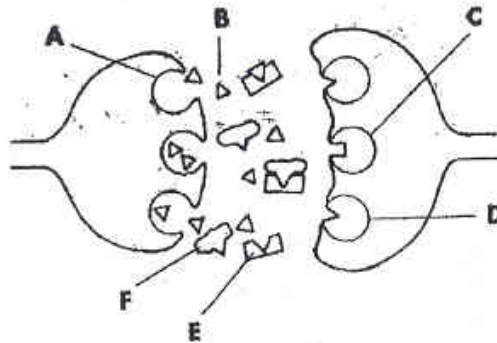
- A 10. The central nervous system consists of
  - a. the brain and spinal cord.
  - b. spinal nerves only.
  - ~~c. the brain stem and cerebellum.~~
  - ~~d. the cerebrum and spinal cord.~~
- A 11. The gray matter of the brain consists of
  - a. cell bodies of neurons.
  - b. only synapses.
  - ~~c. myelin.~~
  - ~~d. nodes.~~
- A 12. Which part of the spinal cord contains the cell bodies of neurons?
  - a. gray matter
  - b. dorsal root
  - ~~c. ventral root~~
  - ~~d. white matter~~
- C 13. Which part of the spinal cord contains motor neurons?
  - a. gray matter
  - b. dorsal root
  - c. ventral root
  - ~~d. All of the above~~
- D 14. Information is carried from the central nervous system to a muscle or gland by
  - a. sensory neurons.
  - b. afferent neurons.
  - ~~c. reticular neurons.~~
  - d. motor neurons.
- C 15. Sensory neurons transmit messages
  - a. from the central nervous system to a muscle or gland.
  - b. from the brain to the spinal cord.
  - c. from the environment to the spinal cord or brain.
  - ~~d. within the brain.~~

I am  
sho you  
reasoned your  
way through  
this section  
using the  
M/C technique



- C 25. Refer to the illustration above. When a neuron is at rest,
- sodium ions are found mostly on the outside of the cell.
  - potassium ions are found mostly on the inside of the cell.
  - ☒ the inside of the cell is negatively charged.
  - ~~All of the above~~
- A 26. Refer to the illustration above. The diagrams indicate that a nerve impulse
- ☒ moves from the inside to the outside of an axon.
  - moves from the outside to the inside of an axon.
  - is the movement of an action potential along a neuron.
  - ~~moves slowly.~~
- B 27. Refer to the illustration above. When an impulse moves down the axon,
- ~~sodium ions first rush out of the cell.~~
  - ☒ a small part of the axon momentarily reverses its polarity.
  - ~~the resting potential of the cell does not change.~~
  - potassium ions are pumped into the axon.
- A 28. Refer to the illustration above. An action potential may be described as
- ☒ an electrical impulse.
  - an electromagnetic message.
  - a chemical message.
  - ~~a chemical change occurring in the brain.~~
- C 29. Electrical changes in a neuron create
- ~~a stimulus.~~
  - an electrical shock.
  - ☒ an action potential.
  - light and sound.

STUDENT #1  
44



- A 30. Refer to the illustration above. In the diagram, label "B" indicates a
- ☒ a. neurotransmitter molecule.
  - ☐ b. neuromodulator molecule.
  - ☐ c. receptor protein molecule.
  - ☒ d. psychoactive drug molecule.
- C 31. Refer to the illustration above. If neurotransmitters could not be cleared out of a synapse after transmitting a message,
- ☐ a. a second neuron would continue to be stimulated for an indefinite period of time.
  - ☒ b. the first neuron could not pass on its impulse.
  - ☐ c. neuromodulators would be formed in the synapse.
  - ☒ d. the neurotransmitter would mimic the effect of a psychoactive drug.
- C 32. Neurotransmitters are
- ☒ a. electrical impulses.
  - ☐ b. found only in neurons with myelin sheaths.
  - ☐ c. released at synapses.
  - ☒ d. produced by muscles.

### Completion

Complete each sentence or statement.

33. Nerves that control breathing, swallowing, heartbeat, and the diameter of the blood vessels are found in the brain stem.
34. The brain and spinal cord are surrounded by three protective layers collectively called the meninges.
35. All of the nervous system outside the spinal cord and brain is known as the peripheral nervous system.
36. The division of the autonomic nervous system that controls stimulation of internal organs during routine conditions is called the parasympathetic nervous system.
37. A sudden, involuntary movement in response to a stimulus is called a(n) reflex.
38. A(n) neuron is the basic unit of communication of the nervous system.
39. The junction of a neuron with another neuron or muscle cell is called a(n) synapse.

Name: \_\_\_\_\_

ID: A

STUDENT #1

Essay

3 SENTENCES MINIMUM!! (3 points)

40. Briefly describe how sensory receptors help you maintain posture and keep your balance. Write your answer in the space below.

Sensory receptors maintain posture by receiving info from the stimulus then sends them over to <sup>the</sup> neuron. Then the motor neuron goes to the muscle or gland. Then the sensory neuron met up with a motor neuron at a synapse and formed an interneuron. This all works together to help keep your balance and posture.

How is the Brain involved -1



Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

ID: A

STUDENT #1

## Spinal Cord and PNS

### Multiple Choice

(2 points EACH USE DEDUCTIVE REASONING)  
Identify the letter of the choice that best completes the statement or answers the question.

- A 41. Neurons are classified by the  
a. direction in which they carry impulses.  
b. amount of metabolic activity that takes place.  
c. ~~number of dendrites that branch out.~~  
d. ~~number of impulses that they carry.~~
- C 42. What is the function of neurotransmitters?  
a. to transmit nerve impulses through dendrites  
b. to stimulate the production of epinephrine  
c. to transmit nerve impulses across synapses  
d. ~~none of the above~~
- C 43. For a neuron to reach an action potential, it must  
a. ~~release electrons.~~  
b. ~~absorb calcium.~~  
c. reverse the electrical charge across the cell membrane.  
d. take in sodium ions.
- B 44. The division of the nervous system that helps the body react to pain is the  
a. ~~somatic nervous system.~~  
b. ~~sensory nervous system.~~  
c. autonomic nervous system.  
d. ~~sympathetic nervous system.~~

### Modified True/False

(1 point EACH)

Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

- F 45. The propagation of an action potential is slower in myelinated axons than in axons that lack a myelin sheath.  
faster
- F 46. The brain and spinal cord can withstand considerable trauma due to the meninges acting as a shock absorber.  
cerebral spinal fluid
- T 47. If you accidentally step on a tack with your bare foot, the pathway that the nerve impulse takes from your foot to your leg is called a reflex arc.
- T 48. The autonomic nervous system is part of the motor division of the peripheral nervous system.



Name: \_\_\_\_\_

STUDENT #1

### Completion

Complete each sentence or statement.

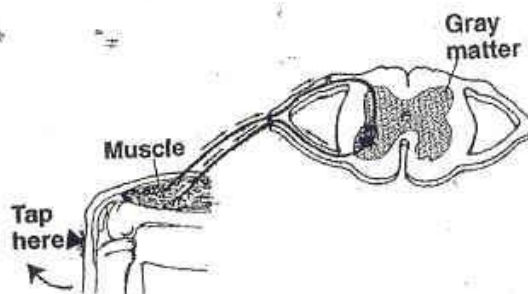


Figure 35-3

- 4 a The process illustrated in Figure 35-3 is called a(an) knee jerk reflex  
b The turning of your head is controlled by the somatic nervous system, which is part of the peripheral nervous system's motor division.

- Short Answer 2 SENTENCES MAXIMUM!! (2 points EACH) carries  
250 Distinguish between the functions of dendrites and axons. dendrites - send impulses through cell  
51. At what location does a neuron transfer an impulse to another cell? axon - sends impulses out from cell body  
52. How is the spinal cord like a major telephone line? synapse  
53. What is a motor neuron? it sends messages out in all directions  
sends impulses out to muscles or glands

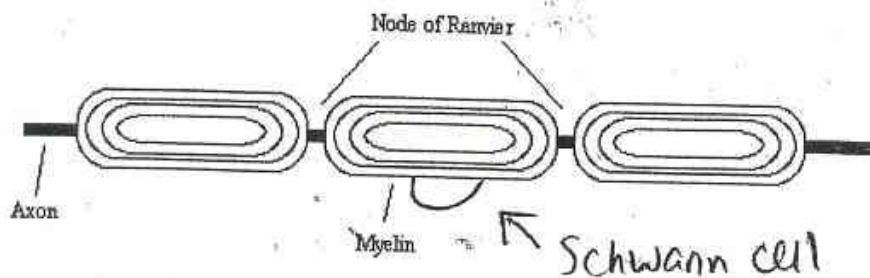
- Essay 3 SENTENCES MINIMUM!! (3 points EACH)  
54. Compare resting potential and action potential in a neuron. The charge across what part of the neuron?  
55. Compare the effects of the sympathetic and the parasympathetic divisions of the autonomic nervous system.  
56. When there is a resting potential the charge is negative.  
57. When there is an action potential the polarity is reversed and becomes positive. So they are different when the charge of the neuron changes.  
58. The sympathetic division controls "fight-or-flight." The parasympathetic division controls the stimulation of internal organs during routine conditions. The sympathetic division works to tense up neurons and the parasympathetic calms the neurons down after.

56.

STUDENT #1

1 point EACH

4/8



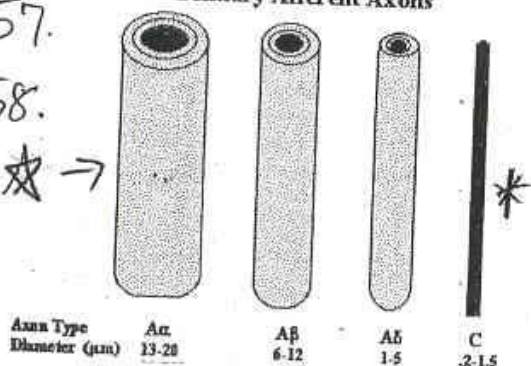
56. WHERE WOULD A SCHWANN CELL BE LOCATED ON THIS DIAGRAM ABOVE?

57.

58.

★ →

Primary Afferent Axons



57. PUT A STAR (★) (AND AN ARROW POINTING) TO THE LEFT OF THE AXON WHICH WOULD HAVE THE FASTEST CONDUCTION VELOCITY?

58. PUT AN ASTERISK (★) TO THE RIGHT OF THE AXON WHICH WOULD HAVE THE SLOWEST CONDUCTION VELOCITY?

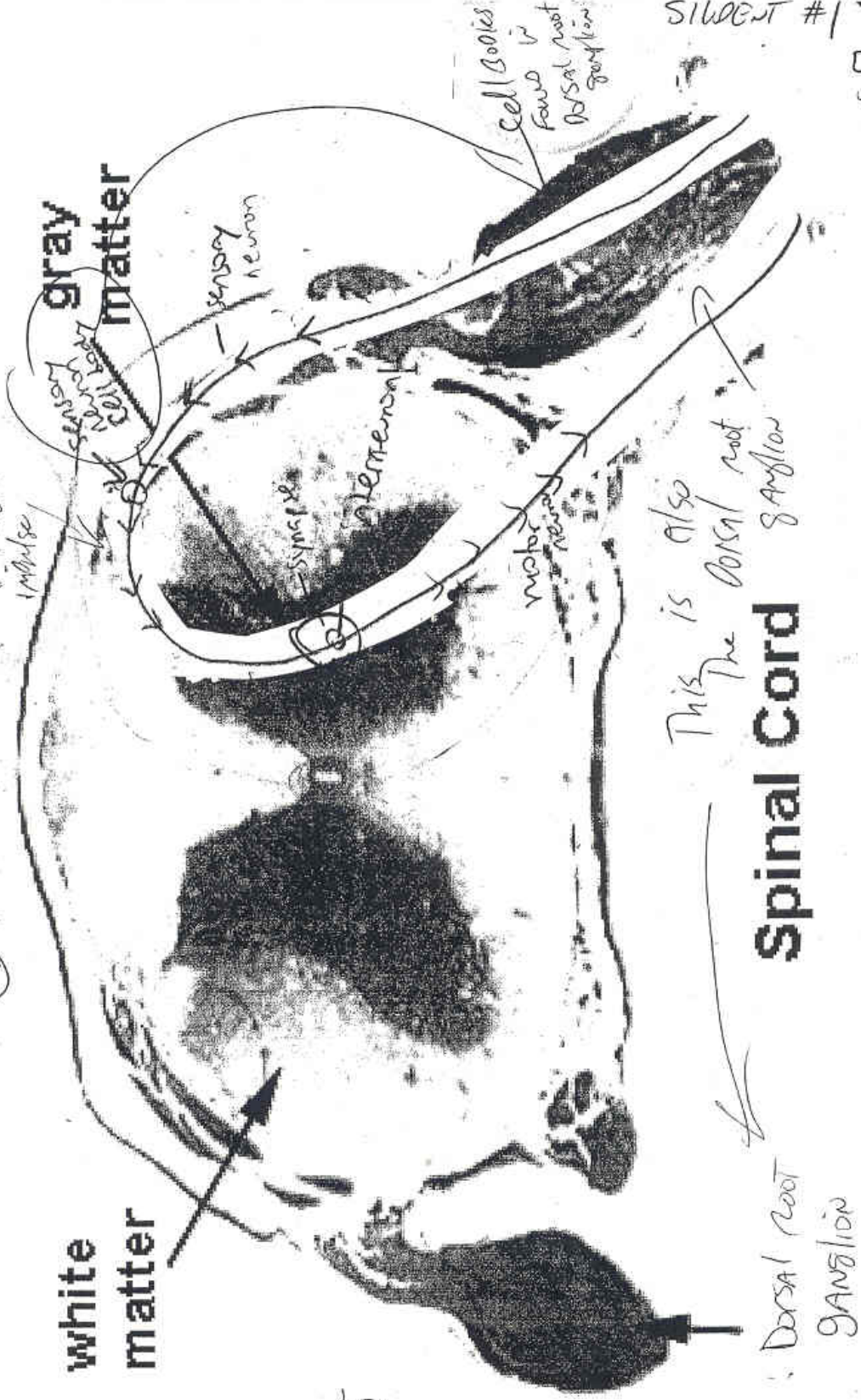
59. LOOK AT THE MRI IMAGE OF A PATIENT CERVICAL SPINE. DRAW AN ARROW TO AND LABEL THE SPINAL CORD. ALSO CIRCLE THE DISC WHICH APPEARS TO BE PRESSING ON THE SPINAL CORD.

DRAW AND LABEL  
60. (1 point per structure)

- ① SENSORY NEURON
- ② SENSORY NEURON CELL BODY
- ③ INTERNEURON
- ④ MOTOR NEURON

SHOW SYNAPSES  
BETWEEN SENSORY, INTERNEURON  
AND MOTOR NEURON

good work  
probably be  
improved



STUDENT #1

50



## **Inquiry Lab: What factors affect reflexes and reaction times?**

Your mission is to design an experiment, which will examine what things can affect reflexes and reaction times using the skills you learned such as reflex testing, using the reflex hammer, the Jendrassik maneuver, the pupil reflex, and testing someone's reaction time.

Did you ever wonder if your reaction time is faster or slower at different times of the day? What other types of changes can affect reaction time? What could make a difference?

Start by stating a problem or making a statement to be investigated? For example "I believe that a full moon will affect reaction time." (You cannot use that one.) Then decide what steps need to be performed to test or investigate the problem. For example, you could test a person's reaction time during a full moon, the day before a full moon, etc. When you are composing your procedure, you need to figure out how to make sure you are only testing one variable at a time.

*You will work with a partner(s) in constructing the experiment and gathering data, but every person needs to write their own report*

**The following guidelines are for your safety and success.**

1. All lab safety rules must be followed.
2. The teacher must check your problem and experimental procedure and approve it **before you begin.**
3. Every person has the right to refuse to be a test subject! Make sure you ask permission before you test somebody for any type of test reflex or reaction time. For example, if you are going to check a patellar reflex, you must ask the test subject for permission first, and also ask if they have any problems with the area to be tested. (Who knows maybe they had a nasty crash on their skateboard yesterday, you don't want to make it worse!!!)

## **Inquiry lab: What affects reflexes and reaction times?**

### **Format for lab Write-up**

**Your lab report will have six sections.**

I. Title: Title should be descriptive (describe the main idea of the experiment that was done). This should be short (less than ten words). Include your name first then follow with name of your lab partner.

II. Problem: State the reason the experiment was done. What was the experiment designed to investigate?

III. Materials: List all the materials which were used in the experiment including the safety equipment.

IV. Procedure: Summarize the experimental methods which were used to perform the experiment or test.

V. Results: Display results of your experiment. Include **tables** that display the data you collected. Also, create a **graph** with reaction time on the 'Y axis and the factors you wanted to examine on the x-axis.

VI. Conclusions: State what you can conclude from the results. Deal directly with the data here. Discuss how the data you collected explains, reinforces or does not reinforce the statement of the problem which you made in part 11.



## **STS PROJECT**

### **Spinal Cord Injuries and Society**

The purpose of this project is for you to investigate one possible solution for the treatment of spinal cord injuries. There are different approaches to the problem of fixing the spinal cord or figuring out a way for a person to live an independent life without an intact cord. One approach is to use electrical technology and computers to stimulate the muscles of the legs and arms. Remember when I demonstrated the muscle stimulator in class? It was able to move my hand in response to electrical stimulation of the nerves. A much more complex system is Functional Electrical Stimulation or FES. Another approach to treating these injuries is to use stem cells to repair the damaged areas of the spinal cord. Human embryonic stem cell research is a controversial subject that is constantly in the news. Your generation will have to figure out how this technology will be used. By researching this you will be able to make informed decisions when it comes time to cast your vote.

Some areas you may want to investigate:

- Current technology in FES: how does it work, can it allow total movement and independence, how widely used is it as a treatment?
- How are stem cells used to repair injured spinal cord/
- Where do stem cells come from?
- Why is the use of embryonic stem cells controversial? How do you feel about the issue?
- How much is this going to cost? Who deserves to have this paid for? If someone committed a crime, do they deserve to have the treatment paid for?

When using the web to search for information you might want to do a search on stem cells, but narrow it to the issue of spinal cord injuries and treatment.

STS: Websites to help you get started.

<http://faculty.washington.edu/~chudier/free.html>

These websites deal with stem cell technology:

[http://my.webmd.com/content/article/Z-0/~172852645?src=inktomi&condition=Home & Top Stories](http://my.webmd.com/content/article/Z-0/~172852645?src=inktomi&condition=Home&TopStories)

[http://www.sci-info-pages.com/stem cells.html](http://www.sci-info-pages.com/stemcells.html)

These websites deal with FES:

[http://depts.washington.edu/rehab/-sci`/functional electrical stim.html](http://depts.washington.edu/rehab/-sci`/functional_electrical_stim.html)

<http://www.differentstrokes.co.uk/functionalelectricalstim.html>

<http://www.makoa.org/nscia/index.html>

General information on spinal cord injuries:

<http://www.spinalcord.uab.edu>

## **Rubric for STS project Spinal cord injuries and society.**

1. Select a topic to investigate by 3/9/04
2. Choose from writing a paper, constructing a poster or PowerPoint presentation to present your findings.

**Project guidelines: Note: All projects must include at least two sources of information, and these sources must be displayed on the project.** URL's are fine to use for now, but ask you English teacher if there is a better way to list references.

### **Paper guidelines:**

Length at least 1.5 pages. Ariel font, size - 12, 1.5 or double-spaced, margins no bigger than 1 inch top, bottom and sides.

### **Poster guidelines:**

No smaller than 20x24 inches. Text information is typed, ariel font size - 12. Diagrams, pictures, drawings should be included, and references to the source must be clear and on the picture. URL is okay to use as a reference for now.

**PowerPoint:** At least six original slides to cover the topic. *Graphics, pictures, images are important and must have the original source cited.* Choice of font is up to you, however, keep in mind how it will look to the class. Ask yourself: will everyone in the room be able to see it? If the answer is yes, then it is okay to use.

3. You will present your findings to the class in a five minute presentation. After the presentations have been completed you will participate in the discussion of the pros and cons of current and future medical therapies to heal spinal cord injuries. Be prepared to share your thoughts and feelings on the issue.
4. **Completed projects are due in one week on Friday, March 12.**  
**Late work will lose 10 points per day.**

## **Spinal Cord I Injuries and Society**

### **Scoring Sheet**

#### **For Full credit:**

- |           |  |
|-----------|--|
| 10 points | Work submitted on time. When class time was given to work on project, student used the time effectively.   |
| 15 points | Project follows guidelines stated in Rubric.   |
| 20 points | Description of technology either in use or in development that is designed to help those with spinal cord injuries. Did you answer this question: how does this treatment work to repair damage or assist n mobility?  |
| 20 points | The student described in detail some of the challenges that using this technology presents.  |
| 20 points | The student fully identified any bioethical controversy surrounding the use of the chosen technology and its applications. Student elaborated and included examples of those who are for and against the use of the treatment.   |
| 15 points | Class presentation and participation in discussion. You relayed the topic you investigated to the class and any new treatment that you thought might be effective to treat spinal cord injuries and why. You answered the closing questions in full. You were attentive and respectful of differing opinions presented in class. |

Total possible points: 100

Your Score \_\_\_\_\_

Student name:

## **Part C: Commentary on Student Learning**

### **What are the strengths and weaknesses in each student's understanding of the science inquiry processes, as evident from work on the lab?**

Student # 1 correctly designed an experiment to test the effect of gender on reaction time and reflexes. He used all of the methods that we had previously used in a class activity. He identified variables that needed to be controlled to get reliable data and mentioned this in the procedure.

Student #2 designed two experiments that would not allow her to connect and compare reflexes and reaction time. She correctly designed an experiment to test reaction time as affected by arm length, but then she tested the reflexes comparing males and females. This would not allow her to compare reaction time to reflexes because she introduced new independent variables in part 2. However, the strength of her inquiry was that she used multiple trials. She failed to include her data in the formal report. When I asked her about this she said that she could not finish it and the STS project. She didn't seem to care because it really didn't affect her score. That's my mistake for setting up the scoring rubric the way that I did. She taught me a lesson on that issue. She defined arm length in her procedure, and she made an attempt to redefine it in her conclusion. This leads me to believe she would modify and improve this experiment if given another shot at it.

While observing Student #1 in class, he was attentive to controlling variables that could affect the outcome. However, he did not document all of these in his report. This is a common mistake he makes often, and I had to remind him of this. Another weakness was the use of a very small sample size to complete his experiment. He did mention this in his conclusion. Because of the design of the experiment, he was able to see that reaction time could possibly be affected by gender, but reflexes are not. His biggest weakness on this lab was not comparing the results of reflexes and reaction time. Looking back I did not specify that in the assignment.

Both students did participate in class during the discussion. Both students demonstrated a knowledge of designing a testable, measurable experiment, control of variables, and the scientific method. Both students recognized the limitations imposed by time and sample resulted in data that really does not give strong evidence. Both students developed data which demonstrated the variability of reaction time. Student #2 explains this on the videotape. A strength of both students is that they required little help in identifying a problem to be investigated which shows their inquisitive nature. I believe that both students will be able to reproduce this type of method on the CAPT next year.



**What are the strengths and weaknesses in each student's ability to apply science knowledge to make decisions about science, technology and society issues, as evident from the work on the STS?**

Both students chose to examine the relationship and controversy on the issue of stem cells and spinal cord injuries. Both students exhibited strength and weaknesses in their writing. Student #1 showed a critical stance in describing experiments which showed the promise of stem cells to heal neural injuries. His greatest technical weakness was that his writing lacked any real flow and may have been just a string of connected quotes. He did provide references. Student #1 failed to take a personal stance within the writing assignment, but he did actively participate in the class discussion. He did decide to support the development of stem cell technology at public cost to heal those with spinal injuries. Student #2 did a good job examining the issue from a political point of view. She examined the issue from both sides and used examples to highlight her understanding of this technology. She integrated knowledge she acquired not only in this class, but from health class as well. This student used a variety of sources to complete this assignment. She lacked really strong conclusion for or against the use of stem cells but did agree that it should be available to everyone. She did a good job of applying knowledge of the controversy of using human embryonic stem cells, and she came up with a solution to try to solve the problem. At the end of her essay she suggested there may be a way to use stem cells without using human embryos. She offered some information on researchers who are gathering stem cells from discarded umbilical tissue. She recognized that umbilical tissue is not a living organism and therefore would probably not offend those who oppose stem cell research if it means human embryos need to be used.

**What are the strengths and weaknesses in each student's understanding of the unit's main science concepts, as evident from work on the unit's assessment?**

The differences on the unit assessment were notable. Student #1 earned an 85% on this assessment, and student #2 earned a 69% on the assessment. Student #1's strength was on the objective portions of the assessment. He demonstrated his knowledge of the vocabulary and anatomy of the structures studied. His open-ended answers lacked supporting detail, but demonstrated that he was aware of the concepts discussed in the unit. For example, he answered questions 25 and 26 wrong and was unable to explain membrane potential in detail on question 54. His overall strength was in his knowledge of the vocabulary and anatomy. Although student #2 did not perform well on this assessment, she did demonstrate knowledge of the larger concepts. For example, she had answered question #7 correctly and even changed the term positive to negative to make a correct statement (a type of question asked on the last exam). Student #2 went on to get 25 and 26 wrong but did attempt to reason her way through the problem. I feel these questions were flawed or the diagrams may have been misleading as many students

had these answers wrong while evidence existed that they knew the material. This is one reason why I added three points to the test for the class. Student #2's weakness on this assessment was in the vocabulary, but she demonstrated knowledge of the integration of the nervous system and how it allows the human body to react to stimuli on question 40. She mixed up parasympathetic and sympathetic nervous systems on the fill-in portion and on the open-ended question 55. She did perform well on the draw and label task, even drawing the pathway of the impulse. Her main weakness were significant misconceptions in the vocabulary, and therefore, she could not apply it to the open-ended questions.

## Reflection on Teaching and Student Learning

This unit was designed to inform students who have a strong interest in medical field about the role of the Spinal cord and nervous system in responding to the outside world. Biology is a descriptive science, and I wanted to challenge the students to create a controlled experiment to examine reaction time. The lab activity presented a task to the students to design an experiment and collect data. Their results were not dramatic or, in some cases, even correct. However the process was important. While the students were not very expressive in their written answers, with some discussion we were able to come to the conclusion that in a normal healthy person reaction time can be highly variable and reflexes are innate and should always be present, unless there is a problem with the nerves. This is due to reaction time pathways being more complex where the spinal reflexes are simple. In my school there is a strong emphasis on CAPT preparation, and even though these students are in 9th grade I felt a need to emphasize conducting controlled experiments. There are many things I would like to change about this lab. For one, I think I will not use the meter sticks, but rulers instead. Rulers are less cumbersome, and this would allow the students to test people at home and around school. Getting large samples is important for this lab, and in the future this lab will be spread out to allow students to test a variety of subjects. Rulers will affect the data, but only slightly. Another way to modify the lab to increase the contrast between reaction time and spinal reflex is to require the students to examine only the pupillary reflex. I could require the students to grade the reflex as present or absent. Some students were trying to "grade" the reflexes which made the reflex data somewhat confusing. This could be addressed by simply asking the student to grade the knee-jerk reflexes as present or absent. The instructions for the lab need to be modified to ask the students to draw comparisons between reaction time and reflexes. My grading structure seemed to discourage students from analyzing their own data. This needs to be addressed by adding weight to the results/conclusion portion.

The assessment could be improved by adding questions that deal directly with the lab activity. For example, a question would be to explain why the lab groups got a lot of different reaction times, but reflexes did not appear to be different? Students could be challenged to propose a reason based on the nervous system to why the reaction times changed. To take it even further, I should have had the students research what conditions can affect reflexes. I offered these to students as examples, but it is evident that if motivated, students seem to gain a deeper appreciation of the topic when they research it themselves. One thing I learned is that I need to develop stronger alternative assessments. Student #2 did not perform well on the test at the end of the unit, but during the lab and discussion she was able to link how reaction time is affected by the distance

the impulse has to travel. Part of her poor performance on the test came from a lack of clarity on parasympathetic vs sympathetic. Looking back, I did not give enough homework to emphasize these points. In fact I gave less homework than I would normally give because I was concerned about the combined requirements of the lab report and the STS project. I relied heavily on the students to investigate and reinforce the vocabulary on their own. The Word Wall in class is a daily reminder to students to review these terms.

Having students investigate the subject on the "Neuroscience for Kids" website at the beginning of the unit was productive. When we covered the subjects in greater detail, the students had already experienced the terms and had prior knowledge. One of the aspects of this unit I enjoyed was that the teachers I am grouped with in the cluster were open to exploring aspects of the topic. The Math teacher took time to teach the students how to calculate reaction time using the distance data they collected and the formula  $y = \frac{1}{2}gt^2$ . The Health teacher discussed risk factors for spinal injuries, including driving while intoxicated. Reinforcement of the topics throughout the school day contributed to student learning. I think that in the future I will encourage more cooperative planning among the teachers I am grouped with.

A reason I feel this unit is relevant to my students is that many of them live in areas where street violence is a reality. I was surprised to hear a student during the discussion express how having a family member who lives with a spinal cord injury has affected her views on treatment. This is another example of how at ease my students are in class. I attribute this to school culture and a strong effort by my to implement the "Capturing Kids Hearts" program. This program of classroom management seeks to create a safe classroom environment which encourages students to take risks. You will notice on the video how my students support each other by never letting a student "stand alone" at the front of the class. Students spontaneously clapped for each other when another student makes a valid point or takes a risk by sharing their views in class.

Being new to this school, grade level, and block scheduling, I have made several adjustments to my teaching style over the last year. For instance, I have the students participate in activities that allow them to explore without set instructions and rigid questions to guide them through the activity. We then discuss the findings as a class and come to a conclusion. One example was the activity using the funnel with different diameter tubes to model axon transmission and how it affects the speed of conduction. The performance of students on the assessment confirms this. The use of the SmartBoard in my classroom has really changed my teaching. It allows the class to move through larger amounts of material faster because I can integrate notes and bullet points with images and diagrams a lot better than using an overhead and the board. It also allows me to "save" the material that was presented in class, including any modifications and adjustments I made in response to students understanding. This came in very handy because due to wild weather. There were quite a

few absences in this class during the week. Considering how much material and vocabulary we covered, the class as a whole performed well. I feel this daily routine of keeping a hard copy of what was done in class then distributing to the students when they return allows them to focus on what material is important. Outside of school my students have little access to technology.

A drawback of the block schedule is that there is no free period during the day for students to use the computer lab. I have to continue to allow class time for students to complete the required work. One thing that surprised me was how interested students were in the project and how much they shared during the discussion. I was impressed by the student who offered that stem cells could be harvested from umbilical tissue thereby avoiding the whole argument of using human embryos. She took the extra step which was not part of the project requirements (maybe it should be next time) to offer a solution to a bioethical problem. Student#1 had produced a report that was below what I expected from him. He completed the written project earlier than was required, but he kept investigating the subject. During the class discussion, he offered information that a treatment is being developed to treat damaged nerves using nasal neurons. This was in response to the issue that not all treatment needs to come from human embryos. I brought a lot of my professional experience as a health care professional into the classroom during this unit. Students were asked to treat the experimental subjects as their patients and ask permission to insure maximum patient comfort. I emphasized that the students use correct techniques for reflex testing. I specifically left out reflex grading because it is not necessary to teach to students at this level and would detract from the unit material. Teaching students the Jendrassik maneuver helps to reinforce the concept that the brain can affect our reflexes, and this simple distraction to the brain allows the examiner to view the reflexes.